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THE JOURNAL OF GAS LIGHTING
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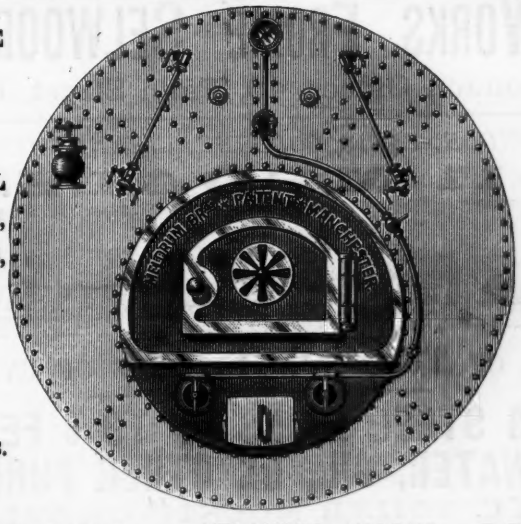

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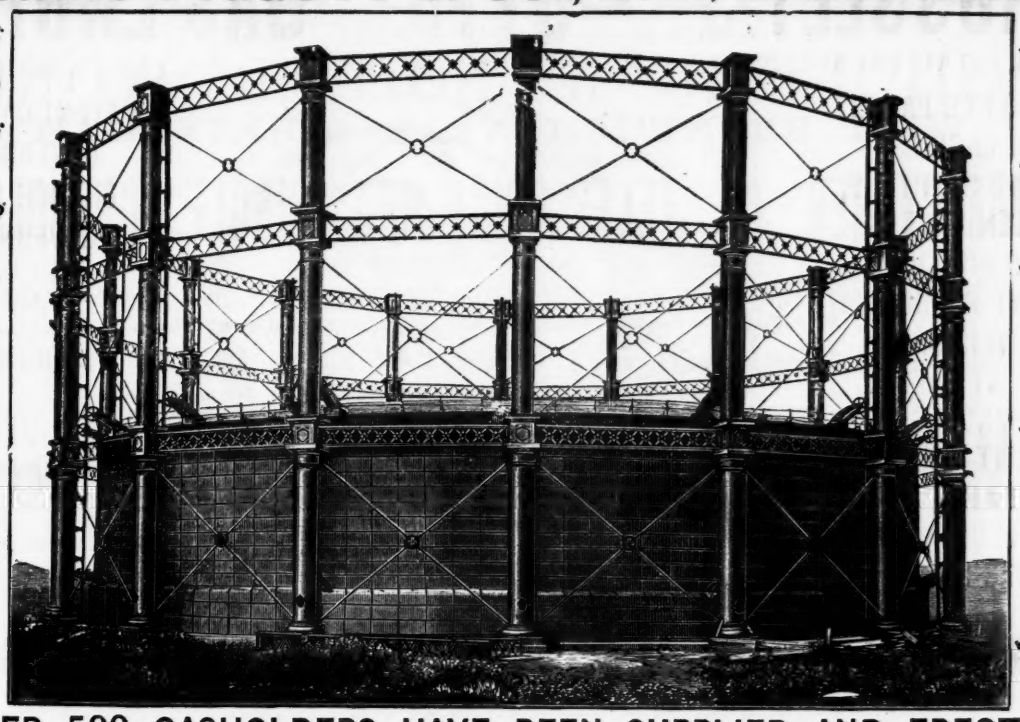

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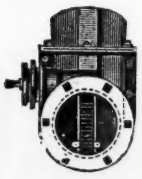

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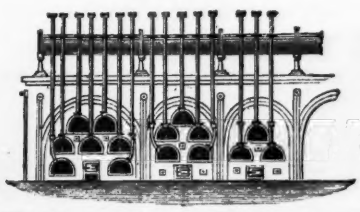

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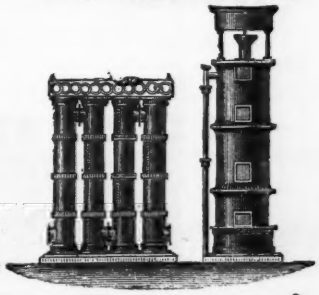

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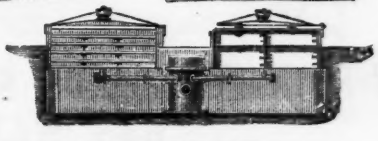

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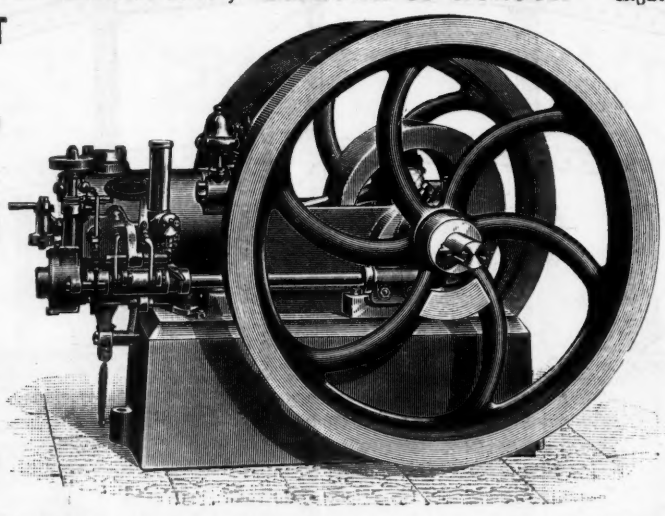

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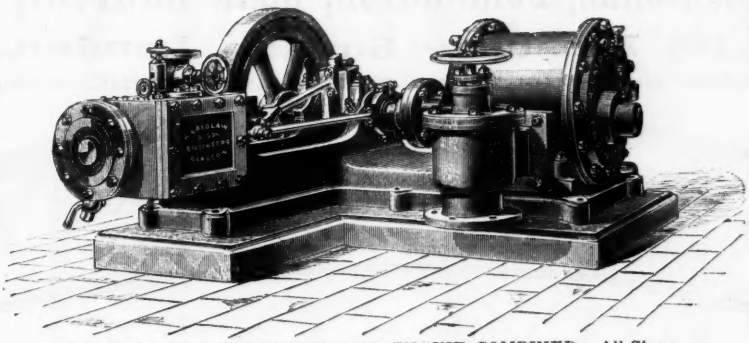

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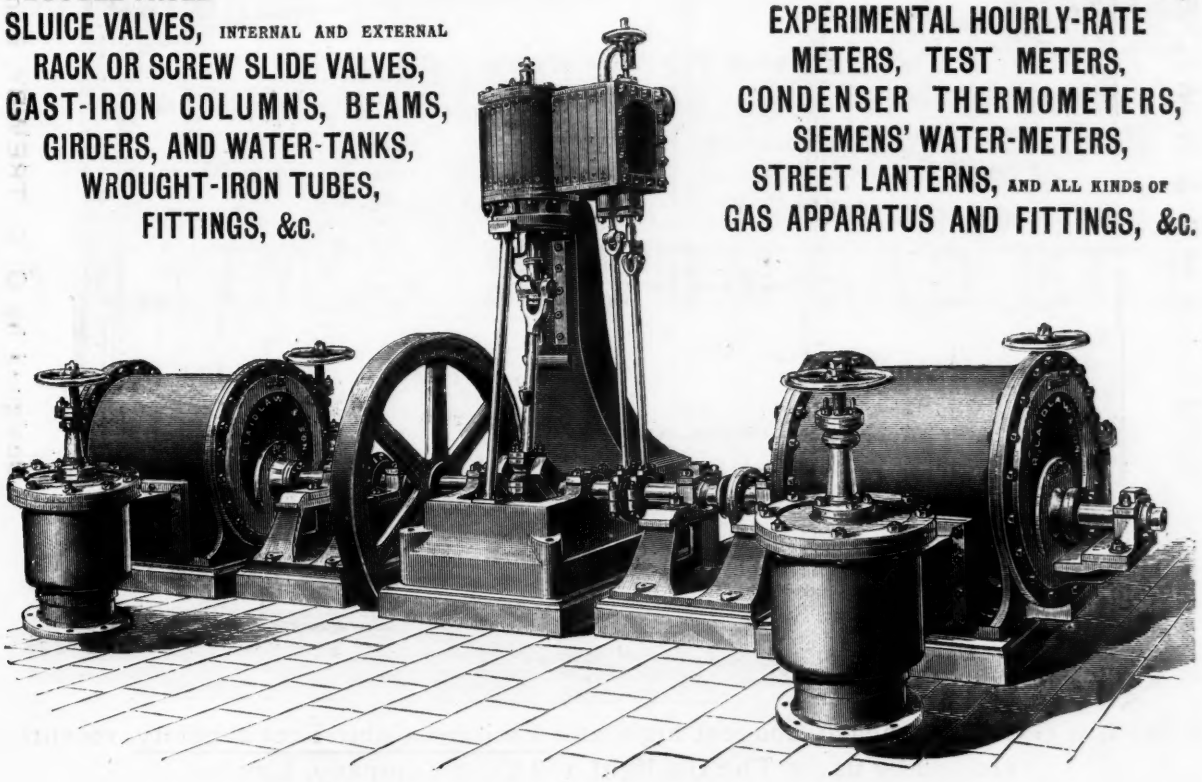

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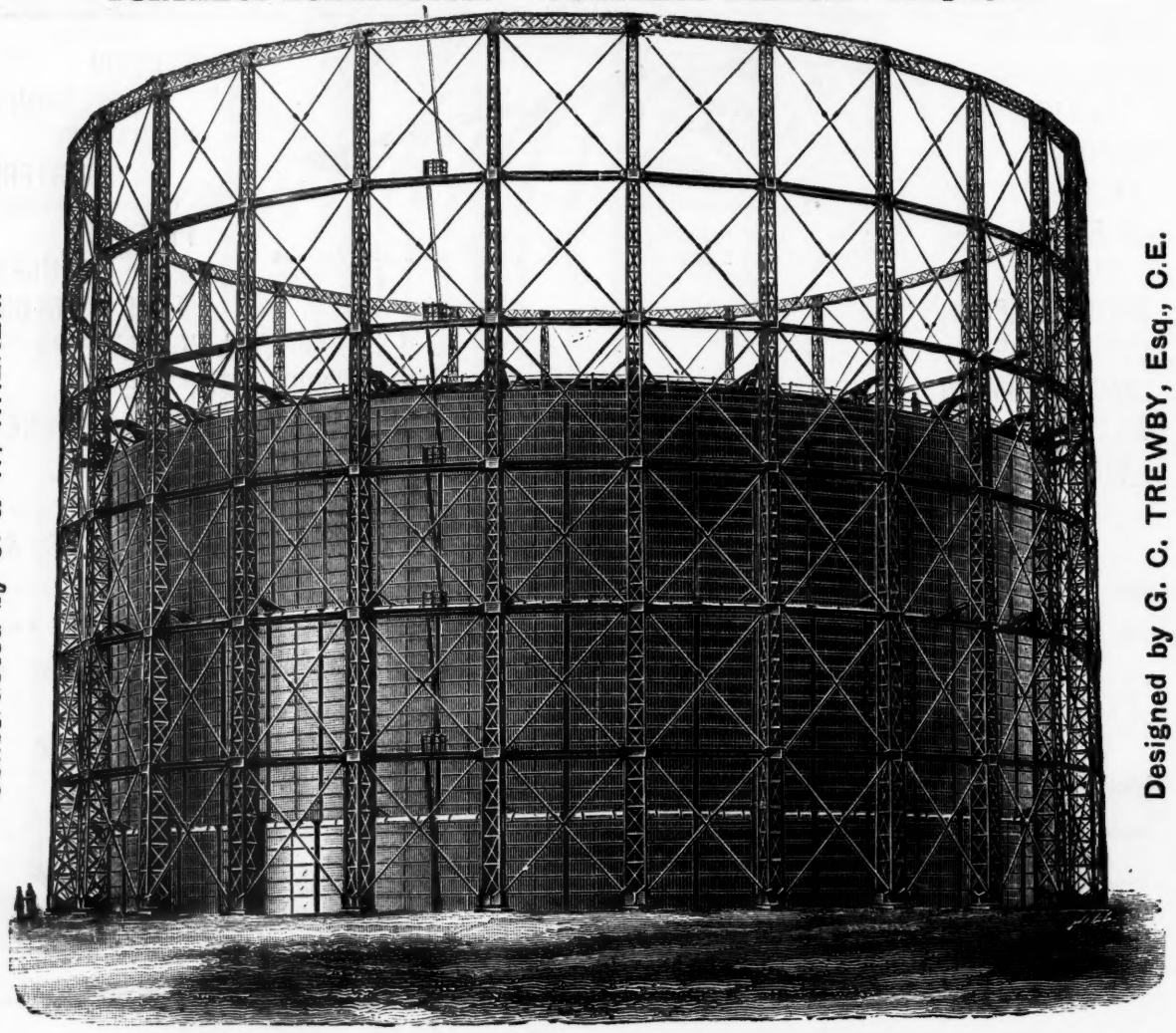

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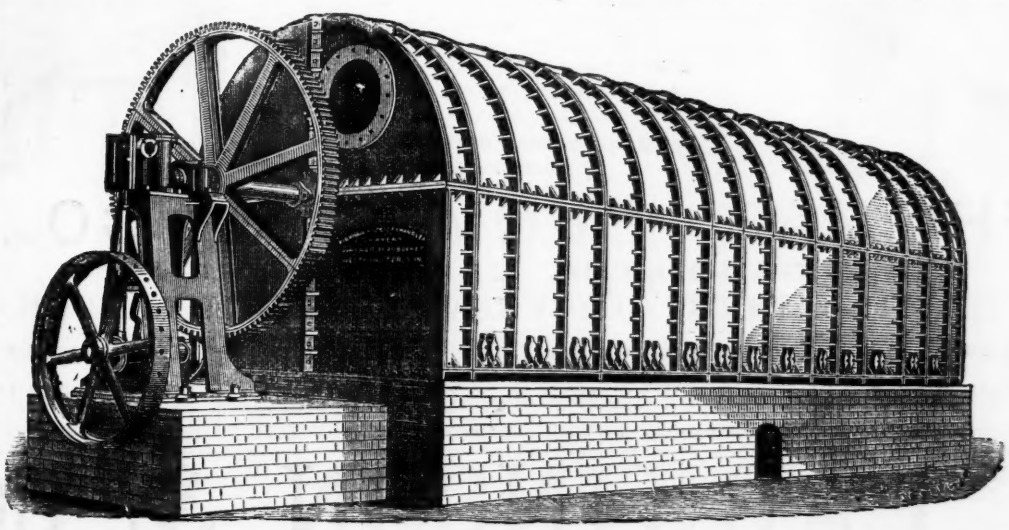

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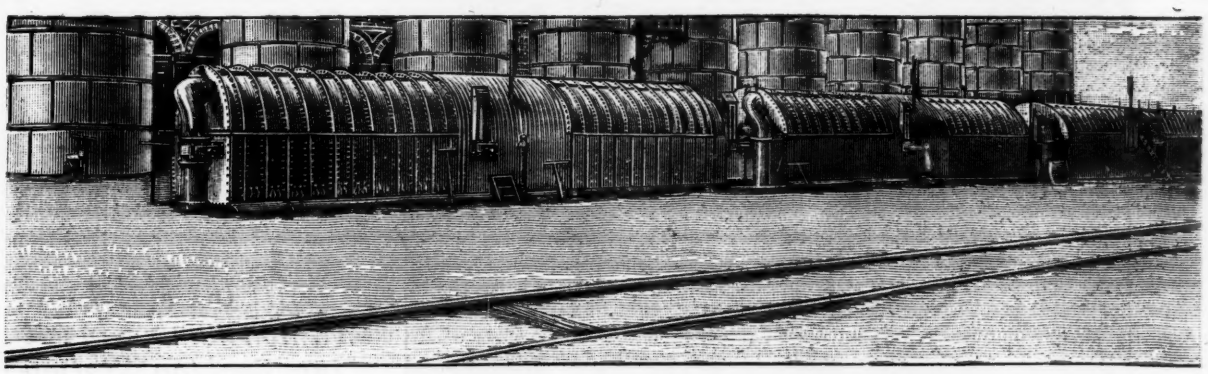

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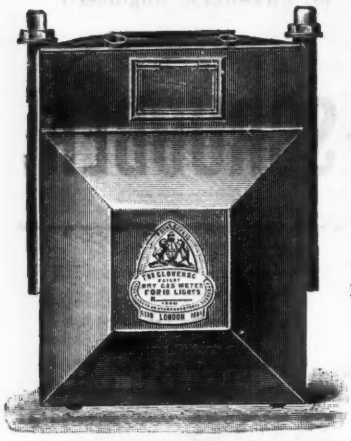

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TUESDAY, JULY 4, 1893.

The Crystal Palace District Gas Company's Bill—Defeat of the London County Council.

THE Crystal Palace District Gas Company's Bill is through the Commons Committee; and the Company are to be congratulated upon having maintained the position in which they found themselves upon issuing from the Lords. We have already commented upon the Bill; and it will be sufficient for the present to remark that the yielding disposition exhibited by Mr. George Livesey when it was a question of arriving at a settlement by agreement with reasonable opponents, disappeared before the Commons Committee, and was replaced by an attitude of inflexible opposition to the pretensions of the London County Council to control the testing of gas in the Crystal Palace district. Now, it is upon record that Mr. Livesey has on several occasions spoken well of the Council; and it may therefore be asked how it is that he has set his face so resolutely against any extension of their jurisdiction, or that of the Gas Referees, beyond the limits fixed in the Act of 1860. Information upon this head will be found in Mr. Livesey's evidence, when it is printed in due course in our "Parliamentary Intelligence." Mr. Livesey is not in the habit of masking his opinions; but he has never spoken more forcibly in support of an impeachment of what he believes to be an injustice than in this onslaught upon the system of gas-testing as applied in the Metropolitan area. He told the Committee how the Gas Referees make the life of the London gas-works manager "perfectly "intolerable;" and how these gas managers are so worried by the Referees and County Council together that "their time and attention are given, to a very "large extent, to these pettifogging matters of testing, "to the neglect of the important matters of the general "management and improvement of the business." And in support of this statement Mr. Livesey narrated how, within the past fortnight, the Council have taken to ringing the changes on the candles used in testing, in order to bring the Gas Companies into default. This story is worth repeating. The South Metropolitan Company's gas has hitherto been tested against candles made by two recognized firms of chandlers—Messrs. Miller & Co. and Messrs. Brecknell and Turner. We believe the Company never interfered in this matter of procuring candles, but took what was prescribed by the testing authorities. Quite recently, the advisers of the County Council succeeded in hunting up some other make of candles, in which they recognized, by some mysterious intuition, a closer approach to the real original "Simon Pure" sperm candle as Parliament knew the article in 1860, than anything that Messrs. Miller, with the assistance of Mr. Vernon Harcourt, have lately turned out. The Council ordered these new candles to be served round to the testing-stations, with the result that the apparent illuminating power of the gas went down from 1½ to 2 candles. According to Mr. H. E. Jones, the Commercial Gas Company were treated in the same way. And this "bolt from the blue" was "engineered" from Spring Gardens while the Board of Trade Committee, of which the Council's Superintending Gas Examiner is a member, is deliberating upon the whole matter of testing London gas. So much was admitted by Mr. W. J. Dibdin, the officia in question. Mr. Livesey having stated that Mr. Vernon Harcourt has taken a vast amount of trouble over the manufacture of candles by Messrs Miller, Mr. Dibdin asserts that the candles have been spoilt. These two "doctors" must settle their disagreement as best they can. We should like to know, however, who besides Mr. Dibdin accepts the new brand of sperm candles burning after the rate of 120 grains per hour—assuming that they answer to this description—as better than those hitherto in customary use. Moreover, is it quite dignified on the part of the County Council to deal in these little surprises? They may perhaps plead the letter of the law; but if the Companies were to do the same, the whole system of gas-testing as carried out in London would come to a deadlock. At any rate, neither Mr. Dibdin nor his chief, Dr. William John Collins, Chairman of the Public Control Committee of the London County Council, succeeded in convincing the House of Commons Committee that the Council are entitled to be placed in the same position with regard to the Crystal Palace District Gas Company as they hold in respect of the London Gas Companies. It was probably the candle trick that did it. In defeating this pretension of the London County Council, the Crystal Palace District Gas Company have prevented the establishment of a precedent that would have been worked against any Suburban Company, in turn, upon the first opportunity.

The Manchester Gas Undertaking.

THE report of the Manchester Corporation Gas Committee for the year ended the 31st of March has been issued, and will be found in another column. The accounts which accompany the report will be given in a subsequent issue. The Committee state that the total

quantity of gas sent out shows an increase of 6·76 per cent. for the year, which must be regarded as very satisfactory. The loss by condensation and leakage has been brought down to 3·6 per cent.—a testimony to the high efficiency of the distribution system. The number of consumers on the books of the department shows an addition of 862 for the year; and there is also a considerable increase in the number of gas fires, cookers, and engines. The Committee are making trial of prepayment meters; and they remark that, although these have not yet proved quite satisfactory, by reason of "the frequent discrepancies between payments made and gas registered, as well as minor defects in the working of the apparatus," it is hoped that these difficulties will be overcome in time, and that a "satisfactory and reliable prepayment meter" will be forthcoming as the result of the energy and perseverance of the makers in effecting improvements in this class of meters. The gross revenue from the undertaking amounted to £555,564, which is an increase of 3·62 per cent. on the revenue for the previous year. The gross profit on the year's working was £104,666; and after paying £25,919 interest, and £13,954 into the sinking fund, there remained a net profit of £64,792, out of which £46,046 was paid to the City Fund in aid of the rates—leaving a balance of £18,746 to be applied to the contingent and renewals fund account. The works are reported to be in good order; but there is still a deficiency of storeage capacity, which is being made good by new holders approaching completion at Gaythorn and Droylsden, and a large holder about to be erected at the Bradford Road station. Nothing is said in the report respecting the state of trade in residuals; and the most satisfactory feature of the accounts, after the general prosperity of the undertaking therein indicated, is the progressive growth of the day consumption of gas. The usual valuable set of statistical appendices accompanies the accounts, from which we gather that, with the solitary exception of 1878, the surplus profits for last year and the year before are the largest recorded in the history of the department. In these circumstances, a renewal of the agitation for a reduction in the price of gas is to be looked for, and can hardly be resisted in face of the cheapness of coal, which will otherwise militate against the popularity of gas for heating and cooking.

The Employers' Liability Bill as Amended.

THE Employers' Liability Bill has been printed in its new form as amended by the Standing Committee on Law. It has been altered very considerably since we noticed its appearance among Government measures; but it is yet far from perfect in the estimation of many people competent to judge of such matters. While the Bill was in Committee, such a cloud of amendments were put upon the paper, that it was difficult to tell from week to week exactly how the matter stood; and the discussion of so many propositions, and the alteration of the text of the Bill to suit the views of a changing majority of the Committee, have had the usual effect of leaving the meaning of the clauses in rather greater obscurity than as they were drafted. The doctrine of common employment is disestablished by the first clause, which enacts that workmen are to have the same remedy for injury against their employer as if they had not been in his service. It was proposed by the Bill as drafted, however, that this remedy should not operate if the workman knew of the negligence that caused his injury, and failed to give notice thereof. Now it is put, briefly, that a workman shall not be deemed to have accepted any risk incident to his employment by reason only of his having entered upon or continued in the employment after he knew of the risk. This puts the onus of proof on the other party, and is more consistent with the conditions of employment. Then comes the provision against "contracting out," which was much debated while the Bill was in Committee. It is proposed that a contract relinquishing any right to compensation under the Act shall not, if made before the accrual of the right, constitute a defence to any action which may be brought for the recovery of such compensation. The practical difficulty in the way of working such a clause grows out of the case of workmen who are entitled to the benefit of accident funds to which the employer has contributed. As originally drawn, the Bill proposed that if an employer so situated was sued for damages, he could recover out of the fund. Now it is proposed that when an employer has contributed to a workmen's benefit fund, and is sued for injury to a workman, the Court, in assessing the amount of compensation due, "shall treat as a payment on account of the employer's liability so much of "any money which has been or will be paid to the "workman or his representatives out of the fund, as is, "in the opinion of the Court or jury, attributable to the "employer's contribution." This phraseology lacks clearness, and would give the Courts a good deal of trouble in many instances. The County Courts are, under the Act, to have jurisdiction for amounts up to £300. In the Act, the expression "workman" includes every person who has entered into or works under a contract of service or apprenticeship with an employer in the United Kingdom or on board a British ship, whether the contract is express or implied, or is verbal or in writing; and the expression "employer" includes a body of persons corporate or unincorporate, and the representatives of a deceased employer. Nothing in the Act is to prejudicially affect any right or remedy to which a workman is entitled independently of it; and any contract existing at the commencement of the Act, whereby a workman relinquishes his right to any compensation for personal injury occasioned by the negligence of the employer, or of any person in the service of the employer, shall not, for the purposes of the Act, be deemed to continue after the time at which the workman's contract of service would determine if notice of the determination thereof were given at the commencement of the Act. This is all very well; but what is the workman to do if the employer is a "man of "straw," or a contractor under a corporation? We should like to be sure that the influence of the Act would not be for the creation and protection of a class of middlemen, and against employers who get their labour at first hand.

Explosives and Petroleum Lamps.

THE seventeenth annual report of the Chief Inspector of Explosives has recently been issued; and, although it does not refer to any particular explosion, or explosive substance, in which readers of the JOURNAL may be supposed to take special interest, the mention made of casualties at home and abroad, due to accidents with petroleum and other inflammable liquids, is worthy of passing notice. Commenting on this part of the report, our contemporary the *Engineer* remarks that "the most extraordinary sacri-"fice of human life is that which takes place in numerous "isolated cases connected with the domestic use of petro-"leum lamps. If the loss of life thus occasioned were to "be concentrated in two or three disasters, public opinion "would imperatively demand some law by which such "wholesale sacrifice should be brought to an end." This is the same point that we have brought forward time and again in these columns, only to be baffled by the principle expressed in the old legal saw, "*De minimis non curat lex*." It appears to be necessary that an admitted evil of the body politic must gather to a notable head before the Legislature, or even public opinion, which is the mainspring of law, will condescend to notice it. A hundred persons may be killed by defective petroleum lamps, or by some other deadly instruments, in different localities and at various times, and nobody seems to either take the alarm or think of adopting any measure with the view of relieving the sufferers. Let a hundred people be gathered together in one place, however, and there and then be sacrificed in a holocaust through a lamp bursting or overturning, and a clamour will be raised and a subscription list opened forthwith. The Government have done all that the actual state of the law permits to encourage the manufacture of reasonably safe lamps; but there is nothing to prevent the production in this country, or the importation from abroad, of the worst kinds of lamps that the exigencies of a "cutting trade" may be held by shopkeepers to demand. It would be too much to ask that all petroleum lamps should be subjected to official inspection, and be stamped before issue to the retail trade; but the newspaper press might do something by awakening local authorities to the danger of bad lamps, and helping Coroners' juries to fix blame in glaring cases upon the culprits who deal in appliances much more deadly than average rat poison.

Bad Times for Trades Unions.

VERILY the Trades Unions, new and old, are entering upon perilous times, which will try to the uttermost the loyalty

of their members and the statesmanship of their leaders. The era of swagger and bounce, with which the mushroom growth of the socialistic type of labour leaders has been identified, is giving place to a period of depression which cannot be expected to sustain so many of these blatant gentry in the positions they have made for themselves. The phenomenal fall in the price of coal has had its natural consequence in the issue of a demand by the associated coalowners whose property lies in the districts embraced by the Miners' Federation, for a reduction of 25 per cent. in the standard rates of wages. A private meeting of representative owners and the Executive Committee of the Federation was held at the Westminster Palace Hotel on Friday last, to discuss the situation, when Mr. A. M. Chambers stated the case of the coalowners, which rests on a comparison of existing prices with those ruling at the time when the present rates of wages were settled. The miners' delegates could not contest the facts; but they urged that they are not empowered to deal with the question. Later in the day, the coalowners who had had the interview with the men reported the result to a large meeting of the trade, at which resolutions were passed in favour of the issue of notices to terminate contracts in order to secure the reduction of wages, such notices to be delayed to enable the Executive of the Miners' Federation to obtain instructions on the subject. At the same time, the employers offer to refer to arbitration the question of the amount of the necessary reduction. Mr. Pickard, M.P., grumbled that the miners did not get any of their advances by arbitration. But on the other hand, it cannot be claimed that they have always obtained what they wanted by other means; and it is to be hoped that the lesson of the latest strikes will not be forgotten.

While dealing with the subject of the labour market, we may remark that the condition of the Hull dockers, after their recent ill-advised performance, is very deplorable. Every day accentuates the severity of the defeat which the agitators sought to conceal at the time under the verbiage of the "agreements" for terminating the strike. The Union leaders have spent all the men's money, and left them in debt; and many of the strikers are still out of work. It is only a just retribution, according to the ruthless operation of natural laws, that labouring men should suffer for the folly of trusting themselves to the leadership of demagogues who clear out when their hare-brained counsels are confounded by irremediable disaster; but it is pitiable all the same. The crushing of the Dockers' Union has been an incalculable gain to the community; but the merciful man must wish in his heart that the burden of defeat did not fall so heavily in such cases upon those who were merely duped into quarrelling with their bread and butter. Nor is it only, as we have said, the new Unions of unskilled workers that are finding the times hard. The Amalgamated Society of Engineers is in troubled waters, thanks probably to the fatuity that brought the organization into discredit on Tyneside last year. The Society has lost heavily, both in men and money, as the report of the Council for the past year ruefully admits. Despite the facts that, during nine months of the year, the whole of the members were taxed to the extent of 50 per cent. on their ordinary contributions, and that this assessment realized the largest amount ever collected in any one year during the history of the Union, the outlay exceeded the income by nearly £23,000. It is recorded that 4844 members left the Union during the year, mostly throwing in their lot with the non-society men; while the recruits were, as a rule, young and untried men. This movement is the result of blundering and mismanagement. It is too often the talkers who get the upper hand in these Unions; and, unfortunately for the societies, these are just the men who do not realize that Socialist dreamings do not compensate for lack of wisdom in the control of affairs. Trade Unions, like all other institutions, must justify their existence, and depend upon their merits for support; and, as soon as the average member begins to suspect that he is not getting value for his subscription, the society is doomed.

Mr. A. Graham, Manager to the Hebden Bridge Gas Company, has been appointed, out of upwards of 60 applicants, Gas and Water Works Engineer to the borough of Mansfield.

Death of Mr. James Brickwell.—The death is announced of Mr. James Brickwell, formerly Chairman of the Tottenham and Edmonton Gas Company. The deceased was in his 86th year.

WATER AND SANITARY AFFAIRS.

THE last public sitting of the Royal Commission on the Metropolitan Water Supply has now taken place; being devoted to the reception of evidence from Dr. Barry, in support of his official allegations, as one of the Medical Inspectors of the Local Government Board, that the water supplied from the Tees was the cause of certain outbreaks of enteric fever. The witness commenced by stating that, if the Commission thought his deductions were invalidated by the evidence of Mr. D. D. Wilson, the General Manager of the Stockton and Middlesbrough Water-Works, he would ask to be allowed to comment in detail on Mr. Wilson's statements, and to have "some days "to marshal his facts." To this rather alarming proposal the Chairman replied that it was impossible for the Commissioners to say what conclusions they had come to, and whether or not Dr. Barry's deductions were borne out by the facts he had already marshalled. The Commissioners had carefully avoided discussion until they heard what he had to say; and certainly they could not hold any further sittings after the present one. Proceeding with his evidence, Dr. Barry withdrew the phrase "uniformity" in respect to the connection between the water supply and the fever, and substituted the word "universality." There was not, he asserted, absolute uniformity. Being asked what, in his opinion, it was essential to prove in order to lay the blame of an outbreak of fever upon a water supply, Dr. Barry referred to the incidence of the attack on the drinkers of the water, as compared with that on the non-drinkers, and said that, in the Tees Valley, the exceptional incidence of the enteric fever was "practically" confined to the users of Tees water. The limitation implied by the word "practically" being pointed out, Dr. Barry said that, in the present state of our knowledge, it was impossible to do more than establish a "presumption"—complete demonstration was impossible. With regard to "uniformity," he argued that there might be particular circumstances in the water area by which large districts would escape the fever. The particles of enteric fever were not diffused equally in the supply. Dr. Barry was asked if he could give off-hand a corresponding instance of this kind; but he signified that he could not. Upon this, one of the Commissioners said he could not understand how a body of 150 or even 100 houses should be able to use the water supposed to be infected, and yet not have a fever case among them. To Dr. Barry, however, no difficulty presented itself, even if 500 houses escaped. His conclusion would remain the same, provided the entire area of supply were large. Accordingly, it would seem that, if Dr. Barry finds fever somewhere in a district, this satisfies his theory, even though large portions of the district, supplied with the same water, have no fever. Finally, the Chairman laid hold of Dr. Barry's statistics, and said a strong presumption was raised in his mind that the witness had received returns for the water districts showing more cases than really took place; while for the non-water districts there was a deficiency. Dr. Barry thought "there might be something in that contention;" and subsequently he admitted that his figures as between the drinkers and non-drinkers were "to some extent falla-"cious." In reply to Professor Dewar, witness explained that it was not from the ordinary state of the Tees he apprehended danger, but when it was suffering from the effect of floods. Having, as we should judge, rather signally failed in giving support to his official statements, Dr. Barry obtained permission to read another report, not previously made public, in which he referred to a prevalence of enteric fever in the Tees Valley. Possibly Mr. Wilson would like to reply to this also; but the Commissioners cannot go on for ever, and they hope to present their report before the arrival of the holidays. Their wanderings in the Tees Valley are now at an end, on which we congratulate them. Certainly, the London Water Companies have received no harm from Dr. Barry.

The Water Committee of the Manchester Corporation seem to have had their own way with the Government in the matter of the sinking fund. Sir John Harwood, at a recent meeting of the City Council, spoke with evident satisfaction of the understanding which had been arrived at with the Local Government Board, and in pursuance of which, the speaker said, the Corporation would be relieved to the extent of £18,000 per annum. This is the

result of long and persistent negotiation, upon which, from one point of view, the Manchester men are to be congratulated. They now calculate upon being able to bring the Thrilmere water to the citizens of Manchester without raising the rates by a single penny. A notable achievement, certainly, and one upon which Sir John Harwood and his colleagues may well congratulate themselves and be congratulated. But the matter has one aspect which is not entirely satisfactory. It means general encouragement to municipal bodies to plead for special indulgence in the matter of sinking funds. When capital is required for the purpose of acquiring or extending water-works, a local authority always chafes at the provisions of section 234, subsection 4, of the Public Health Act, 1875, which purported to fix the sixty years limit for the repayment of borrowed money or the extinction of a sinking fund. The great object always is to wriggle out of this requirement—to get Parliament to extend repayments over a longer period. It has been managed before, and, doubtless, it may be managed again. Hence the encouragement afforded for the financial exploits of municipal corporations. The truth is the Government of the day may find it convenient to be complacent in regard to these importunities, notwithstanding the criticism and disapproval of men like Mr. Leonard Courtney, who are able to discern and point out the mischievous tendency of these special indulgences. In the case of Sheffield, it may be remembered, the Lords Committee, though they allowed the preamble of the Corporation's Bill, declined to vary the rule as to the sinking fund. But in the Commons the promoters were more successful. A period of ninety years instead of sixty years was sanctioned, in order to provide for the annuities under the Bill; the shorter period being insisted upon only for the repayment of borrowed capital. Parliamentary and financial authorities viewed with marked disfavour this encroachment on the established order of things. But the precedent was created; and doubtless it will yet bear more fruit in the form of mischievous results.

Masonic.—Yesterday week Bro. George Clarry, the Secretary of the Cardiff Gaslight and Coke Company, was installed as W.M. of the Glamorgan Lodge of Freemasons (No. 36). This lodge was founded 140 years ago—long before Cardiff had made for itself the name of the "Welsh Metropolis." Despite, however, the great changes that have taken place in the town during that period, the "Old Glamorgan" has kept well abreast of the times; and thus it combines ripe experience with great vigour and enthusiasm.

Mr. Denny Lane's Gas Institute Address.—It having been intimated to Mr. Denny Lane that the subject-matter of his Inaugural Address, recently delivered before the Incorporated Gas Institute in Belfast, is of considerable interest at the present time to shareholders in gas undertakings and others, he has kindly consented to allow the address to be reprinted; and we understand that the Secretary of the Institute—Mr. F. G. Burfield—has the matter in hand, and will be pleased to hear from any members or others desirous of obtaining copies. Early application is necessary, as the supply will be limited.

Gasholders With or Without Guide-Framing.—The discussion between Mr. E. Lloyd Pease and Mr. F. Southwell Cripps on the stability of gasholders without external guide-framing, which recently ran through several numbers of the JOURNAL, has been collected by Mr. Cripps, and printed in a connected form; and in this shape the matter constitutes a useful addition to the published literature of the subject. Mr. Cripps has added to these articles and letters a synopsis of all previous publications, English and Foreign, on the reduction or abolition of the guide-framing of gasholders, and also of the principal literature on gasholder construction generally, brought down to the present time, with a list of English and Foreign periodicals connected with the gas industry.

Laying Large Mains Across the Maas.—Recent numbers to hand of the *Journal für Gasbeleuchtung* supply us with full particulars and illustrations of the method adopted for laying a 16-inch main across the Maas, at a depth of about 25 feet below low water for a length of something like 200 feet. A channel was dredged for the reception of the pipe, which was put together with ball and socket joints, for the lengths intended to be under water. A timber framework was made to support the pipes, the lower ends of which dragged upon the ground, while the other end rested upon a platform built out from the side of a barge to receive it. The lengths of pipe were bolted together upon the upper portion of this framework; and, as the joints were made, the barge was towed forward, allowing the line of pipe to slip down, and eventually to assume the shape of a chain to take up the angle between the slope of the framework and the horizontal of the river bed. In this way the mains were sunk speedily, and without any real difficulty.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTIETH ANNUAL GENERAL MEETING,

HELD AT

THE CITY HALL, BELFAST, JUNE 13TH, 14TH, & 15TH, 1893.

DENNY LANE, ESQ., M.A., President.

DISCUSSIONS ON THE PAPERS.

(*Continued from Vol.* LXI., *p.* 1202.)

PROFESSOR LEWES'S PAPER ON THE ENRICHMENT OF COAL GAS.

Dr. STEVENSON MACADAM said it would be in the recollection of the members who attended the meeting of the Institute held in Glasgow, in 1887, that he then read a paper on the subject now under consideration; and it was published in full in the Transactions of that year, to which the members might refer for details. At that time he had great hopes that the matter would be brought even more thoroughly before the notice of the Institute than it then was; and towards the close of the paper he stated that, "in practical use, it would be advisable to reduce the quality by the admixture of oil gas with thin and feeble gas, or to employ the oil gas simply for enriching inferior gases derived from the more common coals." He had it therefore in anticipation that the process of enriching gas of feebler character by means of gas obtained from paraffin oils would be brought out by practical men, and that they would have it employed in some of the gas-works. But even 1887 was not the first time he had referred to this matter; for he brought it forward as early as the meeting of the North British Association of Gas Managers in 1872. In the concluding paragraph of his 1872 lecture, he said: "These experiments and deductions therefrom are highly suggestive of the future of gas making, and clearly point to crude shale or paraffin oil as the raw material for the manufacture of town gas at no very distant period." At that time the subject was entirely novel; and gas engineers were not quite prepared even to discuss the matter, as he hoped they now were. He remembered the President on that occasion (the late Mr. J. K. Watson, Manager of the Edinburgh Gas-Works), when moving a vote of thanks to him, was very cautious, and simply said: "I hope the results mentioned in Dr. Macadam's lecture will be obtained in the long run." The subject was now beyond the region of mere theory. It had passed from the scientific laboratory, and had to be discussed as a practical question. He had looked carefully through the experiments recorded in Professor Lewes's paper, both in reference to the Young process and his own. With respect to Young's process, the results given in the paper as to the quantity and quality of gas obtainable, and the quantity from a certain amount of oil, appeared to him to not at all exceed those obtained previously in apparatus such as Pintsch's or Keith's. It was stated that one could obtain from a gallon of oil 85 cubic feet of gas of 60-candle power; and, as a better way of getting at a definite result, he had calculated this out to the ton of oil having the specific gravity of ·85. This gave a light-value in sperm candles of 4642 lbs. That was the result of the Young process. Now, in the results he communicated to the Institute in 1887, he found the average in Pintsch's apparatus to be 5150 lbs.; and this was a practical test at works constructed by Messrs. Pintsch, where the process was carried out under his own supervision. In Keith's apparatus also more than six years ago, he found the result was 4571 lbs. It followed, therefore, that the results worked out by Young—85 cubic feet of 60-candle gas, or 4622 lbs. of sperm light—were not so large as those obtained by himself from Pintsch's and Keith's apparatus. Besides this, he might say that, in his own laboratory apparatus, he realized still higher results, and from the same oil. He had made many experiments in connection with the production of this oil gas for lighthouse purposes. The Commissioners of Northern Lights had done him the honour to consult him on many matters connected with the materials employed for lighthouse purposes; and the

question arose in 1879 as to the use of gas, in some form or another, as a motive power in connection with fog-horns. Of course, anything associated with lighthouses was a very serious matter to deal with; and any error occurring might have very disastrous consequences on a stormy night. The subject, therefore, had necessarily to be considered with the greatest deliberation; and he made up his mind then—that was in 1879—that the oil gas could be produced of permanent quality, so that it could be stored for months until required, and that then it might be employed as the motive power in gas-engines. The Commissioners went into the matter, and had constructed, in the first instance, at Langness lighthouse, in the Isle of Man, oil-gas apparatus by Keith, which he went over and saw started. They not only made oil gas there, and had it of a permanent character, but they found it could be prepared with the greatest facility; and even when the fog was coming on, they could start the apparatus in a very short time, and keep up the supply for any number of hours. Not only was the gas readily liberated in this way, and found to be a permanent gas under ordinary pressures, but in some cases it was necessary to employ it in buoys, where it was under great pressure. The results proved that, under a pressure of several atmospheres, it could be stored for months; and then, when liberated, the gas was still found to be of a permanent character.

The PRESIDENT (interrupting) said he hoped Dr. Macadam would direct his attention as much as possible to the two methods mentioned in the paper.

Dr. MACADAM said, with regard to the enrichment of gas which had been referred to as taking place when Young's oil gas was brought into admixture with weaker gas, he should like to know if any experiments had been made in the direction of seeing whether oil gas produced in different apparatus showed the same enriching power when mixed with other gases. He did not see, if one oil gas would increase the original illuminating power 50 per cent., why other oil gases should not, when mixed with feeble gas, be of equal quality of enrichment. There was one curious point on which he should like to ask Professor Lewes a question. He found that the total light which could be obtained from the best quality of paraffin oil was 6885 lbs. of sperm light from a ton of oil. This had been estimated very carefully; and it might be taken as the correct figure. But if he took the enrichment figure of Professor Lewes—85 cubic feet of gas of 90-candle power—it brought up the original weight of sperm, calculated on 85 cubic feet of 60-candle power, to 6933 lbs., or higher than the quantity of light which was capable of being obtained from the oil used in its preparation, when that oil, as oil vapour, was burnt in the best lamps, such as in one of Doty's lighthouse lamps. This was an important point to remember—that the light in fact now, instead of being 67 per cent. of the total light the oil would otherwise have given, was above even 100 per cent. of that which was obtainable from oil in the best-constructed lamps. This observation must be taken in conjunction with the other point shown in the paper, where it stated that, for every ton of oil decomposed, 5½ cwt. of carbon was obtained in the retort; so that they had fully 25 per cent. of the total raw material as residual matter, and therefore only 14½ cwt., or less than 75 per cent. of the original oil, including the hydrogen liberated by decomposition, which would be passed off in the condition of gas. The only other point which had suggested itself to him was with regard to Professor Lewes's own process. He had read the paper very carefully, and it appeared to him, as a non-practical man, to be a rather complicated method of bringing out the result; but this would be for gas engineers rather than for a consulting chemist to consider. His idea of the future was that they should look to the enrichment of the very commonest varieties of coal gas. The production of carbonic oxide and hydrogen to dilute gas was a very simple matter, and was fully referred to in his paper before the Institute in 1887. No doubt it could be carried out in places where ordinary coal could not easily be procured; but if they could get common coal, and obtain from it at high heats a large proportion of gas, even although it might be of very weak quality, it appeared to him that this was the direction in which they should look for the employment of rich paraffin oils in admixtures, rather than the working up of water into carbonic oxide and hydrogen, and using these gases as diluents. There were many advantages which the mixture of ordinary coal gas with the richer oil gas had over the other method. In the first instance, there was a decided smell accompanying common coal gas, which at once arrested the attention, even when small quantities were escaping; and this was a very important safety index. Carbonic oxide and hydrogen obtained from water formed a very poisonous mixture, but gave off comparatively no smell; and this gas might, either by itself or when enriched by oil gas, pass into a room in small, but dangerous and even poisonous quantity, without being discovered. Ordinary coal gas, however, when enriched by the oil gas, still preserved its characteristic odour, and would be readily detected by the sense of smell, which was an element of safety. There was this further advantage, that, if one wished to increase the quantity of gas, it could easily be done, because, after one had distilled over the feeble (though smelling) gas from the coal, there was left behind red-hot coke; and there was nothing to prevent a jet of superheated steam being injected into the retort, and through the red-hot carbon, producing carbonic oxide and hydrogen to increase the supply—more or less care being taken to keep up the temperature of the retort and coke. Of course, a matter of this kind required to be thoroughly threshed out and discussed. He was old enough to know that expressions of opinion put forward to-day might be altered to-morrow; and no one could predict, in connection with any chemical manufacture, what might take place from time to time. In the development of this most important branch of gas manufacture, he did not wish to close his mind to further information, though he thought it right, even on the spur of the moment, to state what his present views were.

Mr. R. MITCHELL (Edinburgh) said there was one point he should like to make very plain, and that was the quality of the oil employed for enriching purposes. He thought Dr. Macadam had made one mistake. He had compared the results now brought forward with those obtained from Pintsch's process. But those who worked this process never used oil of ·895 sp. gr.; Pintsch's oil was ·865. He had tested this gas, not for enriching purposes, but in a very complicated case—viz., that of an oil company who were threatened with a Court of Session action; and he found that at that time they did not get more per gallon than 85 cubic feet of 45-candle gas. This power of enrichment might be equal to that obtained by Mr. Young; but the oil first of all cost more, and one could not get a large supply of it. Therefore, while they had a slightly greater quantity of gas in proportion, they did not get compensated by increased quality. He had had a long connection with Mr. Young, having been his assistant for more than five years; and he had recently paid a visit to Peebles. When there, Mr. Young was experimenting with oil recovered from blast-furnaces—a material which was first distilled, and then made into briquettes. They had now made it practically useful for the Young process of enriching ordinary coal gas. As to permanency, the process described as adopted by Mr. Young entirely prevented the possibility of the gas falling out. It simply could not do it. Some twenty-five years ago, he was making experiments in testing gas-meters with a fluid which would not freeze during the winter. On putting some of the very same oil (·895 sp. gr.) into the meters, he found it washed the illuminating power out of the gas, because the quantity of gas passing through was so small as compared with the surface of oil the gas had to pass over when in the meter. But Mr. Young, in his process, had obtained the quality of gas he wanted, and washed it with the quantity of oil he desired; and it was quite sufficient to render the gas perfectly permanent, and of about 60-candle power. He tested the whole town, and did not find one single drop of condensation in any of the syphons; proving conclusively, to his mind, that there was no condensation. As to the gauging and mixing of the gas, these were points which had not received the consideration they deserved. It was a great mistake to try and mix the gases after they had passed the station meter; and he believed this was one of the mistakes the London Gas Companies were suffering from. The gas to be enriched ought to be combined with oil gas previous to entering the purifiers; so that it had time to become thoroughly mixed before it was sent into the town. This was one of the greatest points in the Young process.

Mr. W. HARDIE, jun. (North Shields), said that all gas managers must feel that this paper was a most valuable

one. The details given of both processes were very full; and they had both evidently passed the experimental stage. Gas managers had, therefore, at last extra methods added to those already in existence, by which gas could be enriched. There were just one or two questions which occurred to him. At the beginning of his paper, Professor Lewes spoke about testing the quality of the gas by its colour, to see that stoppages, &c., were not likely to occur. He (Mr. Hardie) should like to know if it was easy to regulate the process so as to get the gas of the pale lemon-colour described. He also asked if the increased value of the coke over ordinary gas coke was due entirely to its increased density.

Mr. D. Vass (Portobello) said he had seen the Young process at work at Peebles on one or two occasions; and he was satisfied that it could be adopted very readily by small gas-works. There was not much about it which needed very careful manipulation. Any labourer capable of doing what was required in drawing and charging retorts, could attend to it. There was simply a question of turning a valve, in order to allow more or less oil to run into the retort, according to the carbonization and the quality wanted at the time. If the oil being carbonized was shown to be overheated—giving off a browner smoke—a little more oil turned on would cure it. The coke would require to be drawn from the retort once every twenty-four hours. The labour, he considered, was put down in the paper at rather a high figure, instead of a low one—viz., 3d. per 1000 cubic feet. He thought one man would be capable of attending to a good many retorts on this process, seeing that there was very little labour in either charging or drawing—one could do it at one hour, and another at another, and so distribute the work over the day. The production of gas from each retort was a little larger than that obtained from a clay or iron retort; so that the area needed in a retort-house was much about the same. The figures given by Professor Lewes were, he thought, a little misleading, or might not be easily understood at first reading; but perhaps if they had had the paper in their hands a little longer, they might have discussed it better. The cost of producing 1000 cubic feet of Mr. Young's gas was 4s. 2d., which he believed was for 90-candle gas; whereas the cost of the Beckton gas was 2s. per 1000 cubic feet, which he understood was for 25-candle gas, and Mr. Lewes's mixture, 1s. 2½d., which he understood to be of 22-candle quality. These comparisons brought out the enriching value of the gases. He should like to ask Professor Lewes, with reference to his own plant (where there was no external superheater), if the coke decomposed was made to produce carbonic oxide. In the Young process, he saw there was more than 5 cwt. of coke deposited within the twenty-four hours. Would that ratio, he asked, be sufficient to make the carbonic oxide necessary in Professor Lewes's plant? Of course, that would mean that 25 per cent. or thereabouts of the oil used would be converted into fuel to manufacture the carbonic oxide gas. He would also ask if there was any liability for the gas to choke in passing through the red-hot iron, after it was converted into an oxide, as he should fancy the iron oxide would be apt to fall into a powder, and that there would be a liability to choke. However, experience only could decide this point. It appeared to him that great care and attention were needed for the Lewes plant; and that it would not be advisable for small works, but only for works requiring to use it on great emergencies—such as in large cities, where the demand on a foggy day would call out all the resources of the works. He did not think the plant could be relied upon for the permanent enriching of ordinary coal gas in small works.

Mr. C. S. Ellery (Bath) said there was another side to this question, which must be of very great interest; and he should like to hear Professor Lewes's views upon it. For some time he had been making experiments—as yet with no very definite result—by using, instead of oil, the tar which unfortunately at most gas-works was just now of considerably reduced value. There seemed something rather strange about this tar; and he would simply throw out an idea, to hear what Professor Lewes would say to it. This was, whether it would be possible to so alter the system of carbonization as to make the tar more useful in the way of enriching a feeble gas. There appeared no doubt that the Dinsmore process answered in one place, while it might not do so in another; and, as far as he could understand, it would answer in one works at one time and not at another. It seemed to him, from his experiments, that they might in the process of carbonizing at times lose some of the hydrocarbons altogether by overheating the coal and over-decomposing the gases—getting some of the hydrocarbons neither in the gas nor in the tar. The point in his mind was whether they could work at a slightly different temperature—possibly losing something in the gas in the first instance, recover it in the tar, and then use the tar instead of some of these oils. It struck him that, if oil gas were used more extensively, the price of the oil must be considerably enhanced; and when in water gas so large a proportion of the cost had to be set down to the oil, 1d. per gallon would soon make the total figure per 1000 cubic feet look very different. If, therefore, they could use what they already possessed on the premises, it seemed to him it would be of great advantage. He understood that this particular process was as yet only in its experimental stage; but to his mind the idea of injecting oil on to red-hot fuel must end in over-decomposition of some portion of the oil. Even in working oil in a retort, and watching the process very carefully, if the fires were not kept at a steady regular heat, the gases broke up, and choked the pipe with solid carbon; and when it came to be injected into a chamber which he presumed would be at red heat, he should fear that, in practical working, similar results would follow. A small experiment might be carefully "nursed" and watched; but, when it was put into the hands of the sort of men employed in gas-works, and at a time of year when everything was on the strain, he should be inclined to think that, instead of getting gas of high value, they would be choking up the apparatus with solid carbon. Dr. Macadam had made a suggestion which, to his (Mr. Ellery's) mind, was not quite practical, although it looked very feasible. The idea was to inject steam on to the coke in an ordinary clay retort, so as to make water gas; but he fancied this would be very destructive to the retorts. At any rate, he should hesitate before attempting any such experiment. There was one other point which he thought had been rather lost sight of. Dr. Macadam seemed to think this new method of making water gas was not so useful as producing a poor coal gas with the ordinary plant, and enriching it with oil or cannel. However this might be, it seemed to him that they ought to be very grateful to gentlemen who took the pains to make experiments of this kind. The advantage of such a plant in a gas-works would be in the winter, when an increased quantity of gas was required at short notice. At such times this plant could be put to work, and probably postpone the extension of retort-houses. In his own case for about a week or a fortnight in mid-winter, they experienced an unusually heavy demand for gas; and if they had such an apparatus, it would be of very great use for meeting such emergencies.

Mr. D. M. Nelson (Glasgow) said that, encouraged by the remarks of Mr. Ellery on the Dinsmore tar process, he would say that he came to regard this question of enriching gas by oils and carburation very much as a kind of makeshift—as beginning at the wrong end. They knew, as a matter of fact, that, in the ordinary distillation of coal, a very considerable proportion of tars, oils, naphthas, and benzols, instead of being retorted into maximum illuminating power, went to the chemical manufacturer; and a large quantity of tar was left in the coke, which in a great measure produced smoke and chokes, and was comparatively useless as fuel. About a quarter of a century ago, he happened to visit a gas-works at a village in Fifeshire; and he asked the old man in charge how much gas he produced with the particular coal he was using. He said about 7500 cubic feet. He told him he ought to get 9000 or 10,000 cubic feet. His reply was: "But we get an awfu' lot o' taur." He evidently thought that this was perhaps an advantage, as, if he did not get value in one way, he did in another; for, when asked if there was any gain in getting this fearful lot of tar, he said yes, because he was serving the "puir" folks a good turn by giving them both "heat and licht"—the fact being that people burning this tarry fuel had light as well as heat. The distillation of coal, so far as the ordinary retort was concerned, was very much in the same condition to-day that it was thirty years ago, without the redeeming feature of yielding light—a boon in those days more essential than in the present times of cheap oil and gas illuminants. In his opinion, the oils and tar, benzols and naphthas, ought to be

kept in the gas to enrich it, and not be sent to the chemical works; and to atone for this, they had to bring in the extraneous aid of oil and carburetting.

Dr. MACADAM said he wished to state, in reply to Mr. Mitchell, that the blue oil he used in the experiments had a specific gravity of ·877.

Mr. J. STELFOX said the subject dealt with in the paper was of great interest to everyone, but particularly to himself. He was committed, for good or for evil, to a Lowe gas plant, which was to turn out about 1½ million cubic feet of gas per day. It had been a matter of the greatest importance to him; and those who had visited the gas-works would have seen that the question of how much gas could be produced per square yard of space was fast becoming a pressing one—so much so, indeed, that the cost would very soon have to be a secondary consideration. The great inducement to him to recommend his Committee to take up the water-gas experiment, was that they should be able to produce 1½ million cubic feet of gas on a small piece of ground that had been set aside in the hope of being able to turn out 300,000 cubic feet by the use of inclined retorts, and at the same time to save them from having to deal with so much coke, although their market for this residual was good, and that was the reason they wished to preserve it. They did not want to force the sale as it was made every week. He felt that he was only a learner in an elementary class on this subject; and he was anxious to know what was to be said thereon. But, while sitting at the feet of Professor Lewes, he should like to be quite certain that the stool on which he was sitting was pretty substantial. There were a few figures which had already been explained, the repetition of which, he confessed, greatly surprised him; for instance, that 5·65 gallons of oil were required per 1000 cubic feet of carburetted gas. This, as was explained even by Mr. Goulden himself, was a result obtained with inferior oil, which, before they could use it, had to be redistilled, and therefore it was not a fair figure. He did not think there was any breach of confidence in saying that the arrangement the Belfast Corporation had with Messrs. Humphreys and Glasgow was that the use of oil should not exceed 4 gallons per 1000 cubic feet of gas. The difference between 5·65 and 4 gallons made an important alteration in the calculations; and Mr. Glasgow stated, in a discussion which took place a short time ago in London, that he was prepared to guarantee a similar quality of gas with 3¾ gallons. Then, with regard to the cost of oil, of course in inland towns he could not say how it was to be carried, or the cost; but again he was not committing any breach of confidence in saying that in ten minutes he could arrange for three or five years' supply of oil at 2½d. a gallon on the works. Here also was a great difference. He had gone very carefully into the matter; but he had had no experience to look to. He could not at all see how gas of from 24 to 26 candle power was going to cost them more than 1s. 5d. per 1000 cubic feet into the holders, and 18-candle gas 1s. 2½d. In quoting Mr. Goulden's figures, it must be remembered that the results between Beckton and Kensal Green varied considerably; and Professor Lewes had taken the more unfavourable figures. As regarded the prospective increase in the price of oil from the greater demand, he was assured by the agent of the Russian people that it would probably be the other way, because he believed that the distillate which was likely to be used had been almost a waste product, and that a market was now being found for it in gas-works. It was owing to this, as well as the desire to secure an order which in their case would probably commence with one for 4000 tons of oil, that there was an inclination to bring down the price, and to contract for the longest possible period. Mr. Ellery had referred to the question of tar. He was not sure that, if they could utilize tar in this way, this consideration would not apply. It would bring up the price of tar, and then perhaps Mr. Ellery would be anxious to sell this residual instead of using it for the purpose of enriching gas.

The PRESIDENT presumed Mr. Stelfox did not see any objection to the price of tar being advanced.

Mr. J. M'GILCHRIST (Dumbarton) said he had had the pleasure of visiting the Peebles Gas-Works on more than one occasion lately, in connection with the process now brought under their notice; and he could only add that it was admirably adapted for the working up of tar, as well as oil. He looked upon the Young patent as calculated not only to supply a rich gas at a low price, but also to very materially affect the price of tar. If gas companies and corporations were to use (say) 20 per cent. of tar for increasing the illuminating power of gas, the quantity put on the market for sale would be very much reduced, and the present low price improved. He could say, from what he saw at the works, that not only did coal tar make beautiful gas, but also yielded capital coke, which would bring a good price. He would ask Professor Lewes whether it would not be very much cheaper to begin by enriching a gas made from any cheap coal, rather than a gas having no illuminating value whatever. He should also like him to explain if the ordinary labourer would be competent to work his patent process. He thought perhaps it could only be employed at large gas-works; whereas one of the great merits of the Young process was that it could be used in any works, and required less attention than the ordinary method of gas manufacture.

Mr. H. ASHTON HILL (Wallasey) said the tendency of the discussion so far seemed to lead one to believe that it was quite settled that the proper thing was to enrich ordinary coal gas by oil gas. He considered the question of manufacturing water and oil gas a short time ago, when the prices of cannel were very high, and the receipts for residuals exceedingly low; but even then he failed to see that he could introduce the manufacture of water or of oil gas to compete, as regards cost, with coal gas. There was now a considerable reduction in the price of coal and rich cannels; and he thought this question of oil gas had been put a step or two back. Comparisons on this question should always include the residuals. There were probably no residuals saleable in this process; and therefore this was one in which the cost of gas into the holder should be compared with the net cost of coal gas. Taking the Maxim-Clark process, which cost about 1¼d. per 1000 cubic feet per candle, when Mr. Clark called upon him, he showed him that he was carburetting by means of cannel at a less cost than this; but he also pointed out that a few years back he was really increasing the illuminating value of his gas at less than nothing. This was because he was getting cannel at a slightly lower price than his coal. At that time he was making 20-candle gas at a net cost into the holder of 6¾d. per 1000 cubic feet. This showed very pointedly what could be done by means of coal and cannel; and he had not heard anything advanced on behalf of oil which would approach that figure.

The PRESIDENT asked Mr. M'Gilchrist if he understood him to say that he had seen tar carbonized at Peebles.

Mr. M'GILCHRIST replied that he had. The tar was introduced into an ordinary clay retort.

The PRESIDENT said this had been done by two patentees, of whom he was one. For some time it answered very well under particular circumstances; but afterwards, when Durham coal came down to a reasonable price, there was no advantage in it.

Mr. T. DUXBURY (Darwen) said he should like to add a few remarks, not so much on the subject of the paper, because he had had no experience of it, as with reference to the suggestion of Mr. Ellery as to enriching gas by tar. It would be known to a considerable number of members, though not perhaps to all, that for the past eighteen months he had been working at the Dinsmore process, and it was still going on. For the past eight or nine months, Mr. Dinsmore had been at the Darwen works daily. He (Mr. Duxbury) had no connection with the Dinsmore Company, beyond trying their process; and, as soon as he could give the results, the members should have them, whether they were successful or not. They were now using tar; and he had no hesitation in saying that during the last few weeks the tar for which he could only get 13s. (and this was considered a good price), had been yielding him at least 50s. to 60s. per ton, when using tar and coal in the Dinsmore process, over and above what he got from the coal, less, of course, the cost of making. He could not say they were obtaining any material increase in illuminating power; but they had a greater yield of gas. They were not yet getting a candle power which would satisfy either the Dinsmore Company or themselves.

Mr. W. W. HUTCHINSON (Barnsley) asked Professor Lewes whether his process gave regularity of results, so that it could be depended upon without a large amount of extra care. This appeared to him to be a very important matter; for it was well known that the public at large

would be better satisfied with gas of rather less illuminating power, provided it was quite regular in quality. It was the going up and down 3 or 4 candles which caused dissatisfaction.

Mr. VASS asked leave to add a few words with reference to what he had seen at Peebles, which he had omitted to mention when previously speaking. The product of oil gas from one retort for 24 hours was too much to mix with the ordinary gas during the summer months, so they made common gas of about 17-candle power for 24 hours, and then worked the oil gas for a few hours—sufficient to mix in the holder with the other. This answered the question about stratification. They found no difficulty in keeping the supply in the town quite regular.

Professor LEWES, in reply, said Dr. Stevenson Macadam, who opened the discussion, was a gentleman for whom he had the highest regard. When, in early days, he hardly knew anything about oil gas, and the methods of cracking oil, he used to read and study Dr. Macadam's work; and one of his greatest desires had always been to meet him. He had been gratified that morning; and he should always look back to that occasion with feelings of unmixed pleasure. The services which Dr. Macadam had rendered to the oil-gas industry could not be overrated; and his work in connection with the Society of Chemical Industry, published in their annals, and at the various proceedings of gas societies, was of the utmost possible value. That morning he had been speaking very pertinently; and one of the first points he brought up went to show that some years ago, working with Keith's, Pintsch's, and other processes for oil-gas making, he obtained results as high as, or even higher than, those obtained by the Young process when taken upon the photometrical results. He must, however, remind Dr. Macadam that, when reading that portion of the paper, he interpolated a few remarks; pointing out that one must, in taking results, make them comparable. They gave Mr. Young his claim of 90 candles on the enrichment results; but they could only give Messrs. Patterson, Keith, and Pintsch a claim of 45 to 60 candles, if they took it on their direct photometrical result. Tested in this way, Young gas would not show any advantage over other processes. One did not know their enrichment figures because, as far as he was aware, these gases had never been employed on a large scale for enrichment, and therefore there were no data to refer to. Passing on from this matter, permanency came into question; and Dr. Macadam pointed out that, in the oil gas with which he worked, he had found permanency of a very high order. There was no coal gas which was so permanent as oil gas made by any of these processes; but there was in the oil gas made by the Keith, Pintsch, and other processes, always a small residuum of vapour, which would condense under certain circumstances. If they took Pintsch's gas and compressed it, as was done for train lighting, they found that they had a quantity of liquid which was very rich in certain hydrocarbons of considerable value, which were originally present in the gas; and the condensation of these took something like 10 candles off the illuminating value. If this oil gas had been used simply for enrichment, these bodies would have remained in the gas; and they would be to a certain extent condensed where there was considerable friction. In the United States, and even in London, wherever carburetted gas was being employed, after the burners had been in use a certain time, a black stain began to come round the edge of the slit, and would gradually increase and grow; and, in the American gas, one would see over and over again a little filiform carbon tree growing up over the burner itself, and the burners became choked and practically useless. Even within the last few weeks, this formation had been the subject of investigation;* and it was simply formed by the friction of the burner on the gas. If an enriched gas were made to pass through any finely-divided substance, or even impinged sharply on the strangulation at the mouth of the burner or regulator, some vapours would condense out. They would deposit, and form little drops. In the burners he had spoken of, the deposit was due to the friction of the slit of the burner taking out a small quantity of liquid hydrocarbon, which then became carbonized, and did the mischief. In the Young process, by the washing of the gas, they had a very much more permanent condition of things. They did away with these vapours, and had a permanent gas; and this was the main point of the Young process. There was really nothing else in it that was not in every other oil process. It was simply the one point—the washing by oil of the gas produced, and so doing away with liquid residues and vapour in the gas. Dr. Macadam made a most effective point by asking if he (Professor Lewes) had calculated out what would be the amount of light obtained from the oil by burning it in an oil-lamp; and then he called attention to the fact that the figures given in the paper were in excess of those which could be obtained by burning the oil. At first sight, this appeared like trying to do what was often attempted, though the experiment had never yet succeeded—getting more out of a cat than there was in it. This particular "cat," however, was of a curious breed. Paraffin oil contained certain sets of hydrocarbons. If they were subjected to heat, by decomposing them, one obtained hydrocarbons of other series; and Dr. Macadam would be the first to tell them that, in the experiments (now historical) of Thorpe, Young, and others on paraffin, the cracking of paraffin resulted in the formation of nearly equal volumes of saturated and unsaturated hydrocarbons. He would also tell them that one of the lowest members of the paraffin series—ethane—had an illuminating value of something like 34 or 35 candles; that ethylene, the corresponding member of the unsaturated group, had an illuminating value of 68 to 70 candles, or just double. He could take this paraffin, and, by heating, he could split off from it hydrogen, and make it into ethylene, and get from it the same volume of ethylene that there was originally of ethane. Therefore he doubled the illuminating power at one operation. He suggested that, in this particular process, they had these various changes taking place. There was this alteration in the sort of hydrocarbon present, giving absolutely larger illuminating value than could be obtained from the oil on burning; and not only doing this, but giving carbon as well. With regard to the smell, it was pointed out that carbon monoxide and hydrogen had no smell; and therefore the enrichment of poor coal gas by oil gas was more preferable. But, if Dr. Macadam had worked with water gas and hydrogen, and had enriched these with cracked hydrocarbons, he would not have advanced the theory about smell. Carburetted water gas or carburetted hydrogen had just as strong an odour as coal gas. The hydrocarbons obtained by the cracking of the oil gave to the otherwise non-odorous gas a very strong and distinctive smell, which could hardly be distinguished from coal gas itself. Dr. Macadam concluded by pointing out how feasible an operation it would be to retort a poor coal so as to get a low value of coal gas, and then to inject some steam into the red-hot coke in the retort, and so produce water gas, which could afterwards be mingled with the gas previously produced; and thus the whole bulk of gas could be enriched. This idea occurred in the year 1834 to two inventors who took out patents for it. Ten years later it was again patented; and last year another gentleman re-discovered it, and also took out a patent. This particular method of making water gas had been tried in many ways; but there was one point which always wrecked it. The coke in the retort was, of course, at the temperature of, or a few degrees cooler than, the walls; and the temperature of the retort in which illuminating coal gas of any value whatever had been made was too low to produce water gas of any good. If steam were injected into incandescent fuel, and if the fuel were above a certain temperature—considerably higher than 1000°—carbon monoxide and hydrogen would be obtained; but, as this fuel cooled, if only a few degrees, carbon dioxide made its appearance. In attempting to make water gas by the injection of steam through the red-hot coke left in the retort in which coal gas had been made, hydrogen would undoubtedly be produced. But one would have a mixture of nearly equal volumes of carbon monoxide and carbonic acid gas; and the expense of taking the latter out again would swamp over and over again any economy which might be effected by the process. Mr. Mitchell had criticized Dr. Macadam's remarks; and Dr. Macadam had already replied to them, and had pointed out that the oil used, upon which he based his figures, was an oil having a specific gravity of ·87. Mr. Hardie had asked a question as to the colour of the gas, and the cause of the increased value of the coke. The colour ought to be a lemon yellow. This meant

* A communication on this subject by Dr. Love, the Gas Examiner for New York City, to the *Journal of the Society of Chemical Industry*, was reproduced in our columns last week.—ED. J.G.L.

practically that they had a conversion of the hydrocarbons to a great extent, but that there was still a large quantity of vapours, which could afterwards be washed out, and which were in such a condition that they might be again cracked. If the colour were brown, it would mean that tar was being formed, and this would also be washed out; but it would be of very little value afterwards for making more gas. Therefore the light lemon colour was fixed by Mr. Young as the point to which he liked to carry the cracking. Mr. Mitchell had also made a point with regard to blast-furnace oil. If Mr. Young had obtained from this oil a gas which had a considerable illuminating value, he had been remarkably successful, because blast-furnace oils contained a very large quantity of phenols, and substances of that kind, which did not in any way lend themselves to cracking. He thought at one time that he had found out a method by which these blast-furnace oils could be utilized and converted into valuable illuminants. But he discovered, on extended experiments, that it was not so; and he should be very much surprised if Mr. Young had succeeded in directly cracking these oils.

Mr. MITCHELL said this really was the case. He had visited Peebles only a fortnight previously; and they were working furnace oils.

Professor LEWES asked Mr. Mitchell if he could give the number of cubic feet of gas per gallon, and the illuminating value.

Mr. MITCHELL said he could not state the number of feet; but the illuminating value was about 45 candles.

Dr. MACADAM thought perhaps he could reconcile the two statements. Professor Lewes had referred to the oil coming away from the blast-furnace; but, in Mr. Young's case, he had an oil which came from heaps of black-band when burning, which would yield a different gas from the blast-furnace oil to which the author of the paper had referred. His own experiments entirely bore out Professor Lewes's statement.

Professor LEWES remarked that, if the gas came from black-band, it would be a crude form of shale oil. Mr. Mitchell had pointed out that, when oil gas was passed through a meter containing hydrocarbon, its illuminating value was taken out. If they were to take Mr. Young's gas—the most permanent of the kind—they could, by passing it through paraffin oil, remove 70 per cent. of the volume of the gas containing nearly the whole of the illuminants. Paraffin oil would dissolve out ethylene, and those other substances on which illuminating value depended. It did this in the washing in the Young process; but these gases were again driven out on reheating.

Mr. MITCHELL said he was sorry to interrupt so often; but he thought Professor Lewes was under a misapprehension. Mr. Young, something like twenty-five years ago, was experimenting with gas-meters to find some substance that would not freeze. At that time he employed a blue oil, of the same quality that he was using now. The quantity of gas which was passed through the meter was so very small, that having such a large area of blue oil washed out the illuminating power of the gas. More than twenty years ago they were experimenting with waste gas from shale retorts. They put up a large condenser, 9 feet in diameter and about 80 feet high, and washed down all the oil; and the vapour being re-distilled, they obtained from it an excellent spirit of very light specific gravity.

Professor LEWES, continuing his reply, said that the increased value of the coke was, no doubt, largely due to its density, and also, for metallurgical purposes, to its hardness and resistance to crushing. In a blast-furnace, where there was a large mass to be heated, the crushing resistance of coke was a very important factor in its value. A soft coke like gas coke was useless; it simply pulverized and choked the furnace. Mr. Vass had alluded to the labour with the Young process, and expressed the opinion that he (Professor Lewes) had put too high a figure upon it. But Mr. Vass really spoke as if all that the man had to do was to turn the cock on and off, and occasionally to regulate the flow of the oil. He presumed, therefore, that the retorts and fires kept themselves going automatically, and that the pumping of the oil into the reservoirs, and the other work connected with the process, was also automatic. It would be found that, if they took the making of oil gas on a large scale, taking everything into consideration, his figures would not be very far out, and although undoubtedly they could use a large proportion of the heat that was already present in the flues, still he did not think any gas manager would like to have his process of retorting and firing so far criticized as to say that he had enough waste heat at the back of the bench in his flues to heat a large series of retorts up to 900° and 950° C.; so that there must be extra fuel used somewhere. Mr. Ellery had held out a most tempting bait, and had endeavoured to coax from him some expression of opinion on the question of the carbonization of tar, and the production of illuminating value from it. Heaven forfend that he should dash into any such alluring breach, or attempt to criticize the Dinsmore patent, or to say what was or what was not going on in that much-discussed process. There was no doubt that Mr. Young had carbonized tar in his retorts. He found that, by drawing them very often, and by very carefully regulating the heats and the rates of flow, he could get from 15 to 18 candle gas from tar, and a quantity of coke was left behind; but he thought he was right in saying that he had not gone beyond that. To put it in Mr. Young's words: "I can get from a sample of tar, gas of the same value as the original gas that was made during the production of the tar." That was Mr. Young's theory; but he was not quite sure about the data on which it was founded. He had made a large number of experiments on tar, and intended to carry out many more this summer. In using his own apparatus, he had injected tar into the fuel itself, and found he could get from it a resulting mixture of water gas, hydrogen, and hydrocarbons of varying illuminating power—about 12, 14, and 15 candles. Then, by injecting some oil to top up with, he found he could raise it 4 or 5 candles, and so get 17 or 18 candle gas. Whether or not he could do this continuously, without choking up the plant, he was not at present prepared to say, because it would require a slightly different form of apparatus. But no doubt this power of injection into incandescent fuel, and of burning up the carbon deposit, gave considerable strength in that direction. Mr. Vass also asked two questions about the carburetting gas plant, and as to whether the quantity of coke deposited in the Young process would be sufficient to give the producer gas required. He did not quite know what was meant by the question; but, for every 1000 cubic feet of gas made, he used 35 lbs. of coke—this being over and above anything deposited from the oil. As regarded stratification, Mr. Vass said it did not take place—that at Peebles it was quite possible to make ordinary 17-candle gas from a specified coal all day long, and then produce oil gas and put into it. It was easy to make a mixture in a small holder, while it was almost impossible to do so in one of more than a million cubic feet capacity. The size of the holder was an important consideration; and in using this process (Young's) for enrichment on a large scale, the difficulty of getting an even mixture of the heavy and light gas must not be overlooked or underrated, as, say what they might, it would be found a very real one in large works. With regard to Mr. Stelfox's observations, he might consider he was on ground of the most solid character. He had adopted, or had very properly recommended his Committee to adopt, a process which had proved itself to be successful at Beckton. There they had been making in many cases 5 million cubic feet of gas a day; and at Kensal Green they were also making gas on nearly the same large scale. They spoke of it as enrichment; but when a small works came to make 5 million cubic feet of gas a day, they would be inclined to call it production. But whether it was called production or enrichment, did not matter; the apparatus had been at work making gas. It was a proved factor which might be relied upon; and he could, with a perfectly clear conscience, recommend his Committee to take it up. Still, he would say he intended to defend the figures as to the cost of that gas; and he did so because they were given by Mr. Methven and Mr. Goulden after extended experience. Mr. Methven stated in his recent Presidental Address, and Mr. Goulden assented to it, that the price of 25-candle water gas was 2s. to 2s. 1d.; and it only now remained for Mr. Stelfox and Mr. Glasgow to show that, under the conditions existing at Belfast, they could improve upon the Beckton working. There were one or two other points raised in the discussion, such as the question asked by Mr. Hutchinson as to the evenness of the results. They were quite even enough for ordinary work; and he could certainly rely, by Young's process, on getting fair value if he worked at an even temperature. He should like to continue the discussion much

longer; but it was already late, and he had still to deliver a lecture before the midday adjournment.

The PRESIDENT said they were indebted to Professor Lewes for his reply quite as much as for the paper itself. There was one point in which he (the President) felt very much interested, and that was the clear reasons the author had given why injecting steam into the charge at the end of the retort did not produce the desired result.

PAPERS READ AT THE MEETING.

(*Concluded from Vol.* LXI., *p.* 1207.)

THE SETTING AND WORKING OF INCLINED RETORTS AT MIDDLESBROUGH.

By D. TERRACE, of Middlesbrough.

Certain circumstances—among others the unreliable condition of the labour market during the last few years—have caused several gas engineers to introduce other than the usual means of working their carbonizing plant. Taking everything into account, it will be conceded that it is well we are sometimes compelled to take a departure from the old beaten track, especially when the tendency is to lessen severe bodily labour. The "beaten track" which is particularly referred to by me, in regard to working retorts, had been "trod" in the works I represent for the past thirty years and more. One would have thought that brick ovens (as retorts) and their accessories would have been out of existence by this time. It appears, however, that there are one or two places where they are still in use. Not only were these brick ovens antiquated, but the men had got into a style of work that was not only not conducive to the best interests of their employers, but that even did not agree with their constitutions.

Ever ready to take full advantage of changes—which for the time being, appeared to favour them—in the labour market, the men soon got their so-called grievances remedied by putting the "pressure" on at the right season; the adoption of the eight-hour shifts being the salve to solve their problem. This had been arranged for them a few months before I took the reins of office early in 1890; and so the organizing of these eight-hour shifts was all that fell to my share at that time. The cost of carbonizing prior to the concession of the eight-hour shifts was 2s. 8d.; and subsequent to the reduction in the working hours, the amount rose to 3s. per ton. These are admittedly high figures for "country" work, as I find that in many similar gas-works where the twelve-hour shifts are still the order of the day, the cost is much more moderate. It will thus be readily perceived that means had to be adopted, both in the manner of setting the retorts, and also in the method of working, if we were to hold our own in supplying our staple production cheaply, and at the same time profitably.

There are two retort-houses in the Middlesbrough Gas-Works—the "old" and the "new"—neither of which were suitable for machine-stoking, owing to the limited floor-space, as both houses had been arranged for settings on the antiquated oven system. If any change had to be made, we must either construct the most modern form of clay retorts, with the usual open furnace (as we could not go below the floor-level for regenerative firing), or adopt inclined retorts. The investigations of the author led him to the conclusion that the latter possessed the following advantages:—

(1) Greater carbonizing capacity on the same ground-space.

(2) Regenerative firing could be applied (which could not be adopted with the horizontal retorts, for the reason stated).

(3) A new departure in labour, through charging and drawing by the aid of gravitation, which enabled us to cut ourselves entirely adrift from the old conditions; and consequently

(4) Reduction in the quantity and cost of labour.

It has already been remarked that mechanical stoking could not be applied, on account of the limited floor-space; but we could, by heightening the walls of the new retort-house, put in inclined retorts. So it was decided to erect four through beds of sixes, 24 in. by 15 in. ⏢'s by 20 feet long, as an experimental installation. The new retort-house (built nine years ago), into which it was intended to erect the inclined retorts, measured 104 ft. by 51 ft. by 20 ft. 6 in. high, with coal-stores at each side 27 feet wide. The chimney at one end was 100 feet high, 36 feet area. This had served for nine beds of sixes through retorts, 18 feet long. The roof (iron, 51 feet span) is composed of eleven principals; and our first step was to take down these with the purlins, &c. Then we heightened the 15-inch walls 17 feet, and re-erected the roof; the cost of this being about £800. The walls are now 37½ feet high; this being necessary for our inclined retorts, 20 feet long.

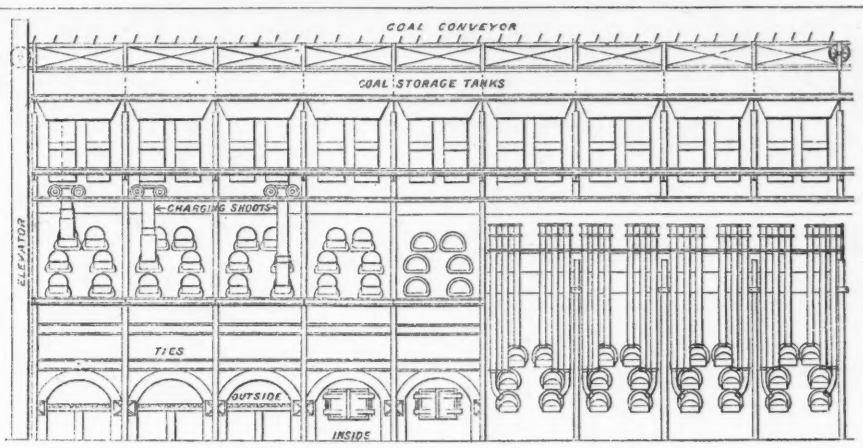
In designing the mode of setting, a difficulty was met in determining what would be the best system of heating by regeneration, as we could not excavate much below the ground-level. We had proposed placing the producers under the charging-stage (at the high end); but we were advised that there would be an insuperable obstacle to that mode, as it was alleged the carbonic oxide gases would not travel from a higher to a lower level—at least, in such a way as to ensure proper combustion. The writer then pointed out that the gases, as such, did not require to travel; but that the heated air coming in contact with the gas at the producer level, combustion then and there would take place, and thus fill the whole retort-bed, thereby forming a combustion chamber, at the lower end of which the waste heat would be taken off to go through the regenerator in the usual manner. Ultimately, the writer decided to carry out this plan; and it is found to work well, giving uniform heat at the lower and the higher levels.

As cold coke had to be used in this arrangement, we adopted double (or twin) producers for each bed. These being filled alternately, allowed of one working at its best, while the other was undergoing cleaning and refilling. These producers are external; and at the bottom of each are tubular bars (laid in V spaces), which, when cleaning, are withdrawn, allowing the old clinker to fall. After replacement, the fresh-made clinker falls on to the bars, and forms the bed for the new mass of fuel. The gases are taken off near the top of the producer through three openings (common to the twin producer), where they meet the heated secondary air; thereby combining, and filling the whole retort-bed. The flame descends through the chequered walls supporting the retorts, towards the three exit flues, between which are the two secondary air conduits—forming a simple regenerator, constructed of ordinary fire-bricks and tiles. There are the usual damper arrangements in the exit flues; and regulating-valves, for the ingress of secondary air. A large dial vacuum gauge, attached on the main flue near the root of the chimney, proved useful in enabling the attendant to regulate the draught at about 4-10ths inch vacuum; this being all that was necessary to obtain the best results.

The main arches of the beds are built of 14-inch end arch-bricks, which at the springing are laid horizontal, and at the apex necessarily vertical; the arch being formed of a series of small stepped rings, tied into each other in such a way that not the slightest indication of settling took place after six months' work, although there were no cross binders, only the usual front and end buckstaves. Owing to the extra height of the beds, caused by the angle of the retorts, these buckstaves were made stronger than usual, being of 12 inch by 6 inch H-section iron.

In lighting at first, the bottom part of the producer was closed; and a small fire was kept up on the stage-level, immediately above the centre opening of the producer. This was done for about a month, when it was found that the whole of the brickwork was thoroughly dry and ready for work. The producers were then kindled, and the draught regulated so that extreme heating was avoided. There was abundance of heat; and it required caution at first in tempering this for the work to be done.

For the 24 through retorts, there were in attendance—eight-hour shifts—two men, who did the work in connection with the producers and charging the retorts; and two men for drawing and wheeling away the coke, who also attended the engine and coal-elevator. As each retort was charged with about 7½ cwt. of coal, we carbonized every six hours 180 cwt. = 720 cwt. per 24 hours—*i.e.*, $\frac{720 \text{ cwt.}}{12 \text{ men}}$ = 60 cwt. per man. Each man was paid 5s. 3d. per shift; so that was about 1s. 10d., as against 3s. per ton carbonized by the old method. It must be noted that this 1s. 10d. per ton was for experimental work (four beds); and doubtless when our full complement of retorts are in



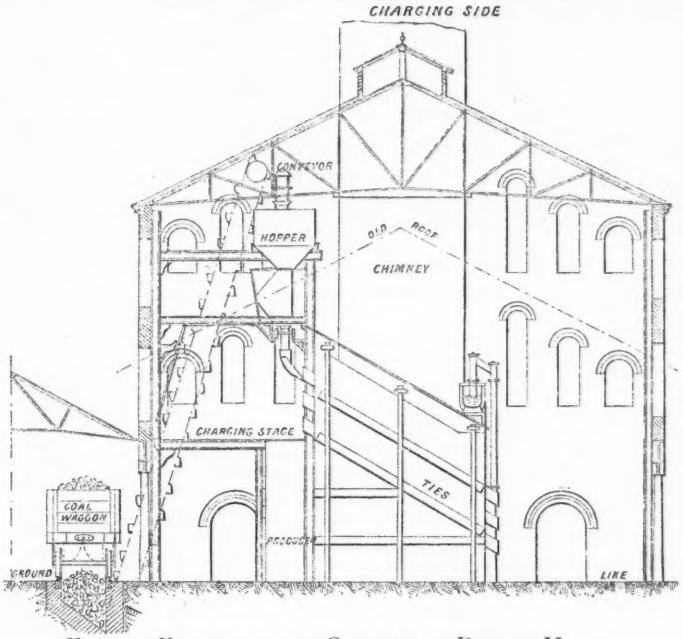


FIG. 1.—ELEVATION AND SECTION OF RETORT-HOUSE

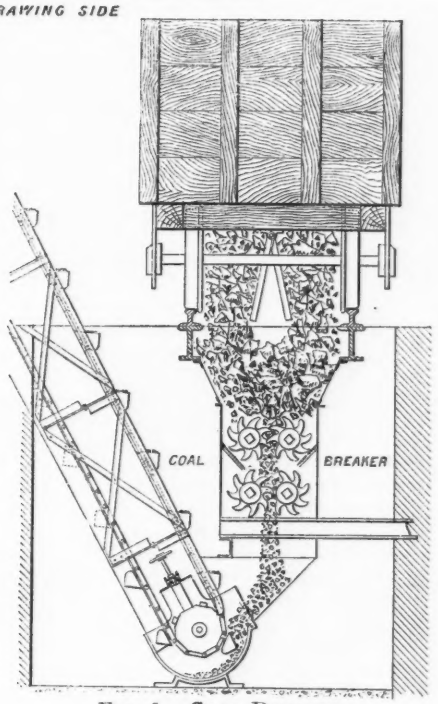


FIG. 6.—COAL BREAKER.

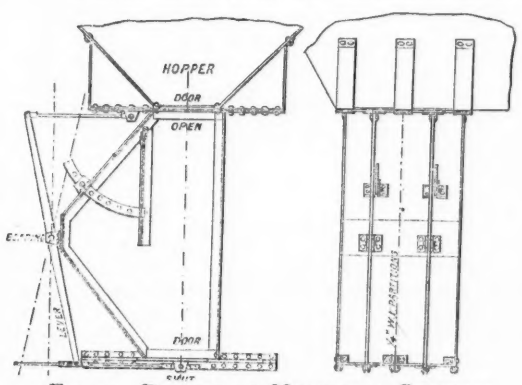


FIG. 2.—DETAILS OF MEASURING CHAMBER.

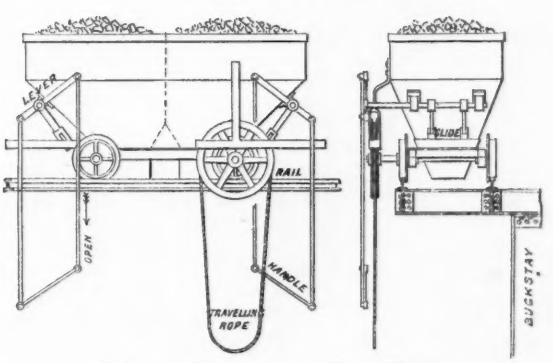


FIG. 4.—DETAILS OF COAL TRUCK.

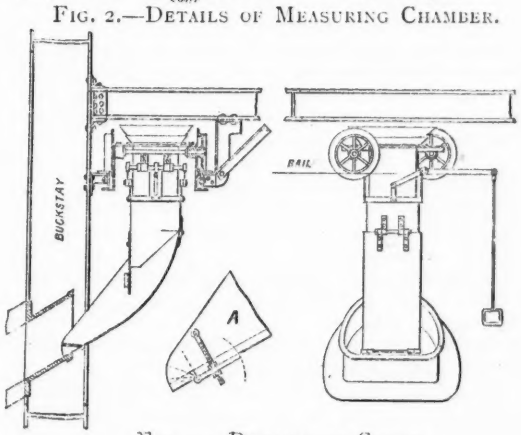


FIG. 3.—DETAILS OF SHOOT.

operation—*i.e.*, the nine beds—the labour account will be considerably reduced; as with the extended plant, comprising all the latest improvements depicted on the diagrams before you, the cost for labour should not exceed 1s. 6d. per ton of coal carbonized, including every working item, from the time the trucks of coal are received into the stores till the coke is laid into the yard, or broken and loaded into railway trucks from the elevator. Thus, there will be in attendance—eight-hour shifts—three men for the work in connection with the producers and charging the retorts (as the work of charging will be much lessened with the continuous coal-hopper arrangement, fewer men in proportion will be required than with the central coal-tank and charging-trucks, &c.), and four men for drawing the retorts, wheeling away coke, &c. These drawers will not now do any attending to elevating coal, &c. We shall thus

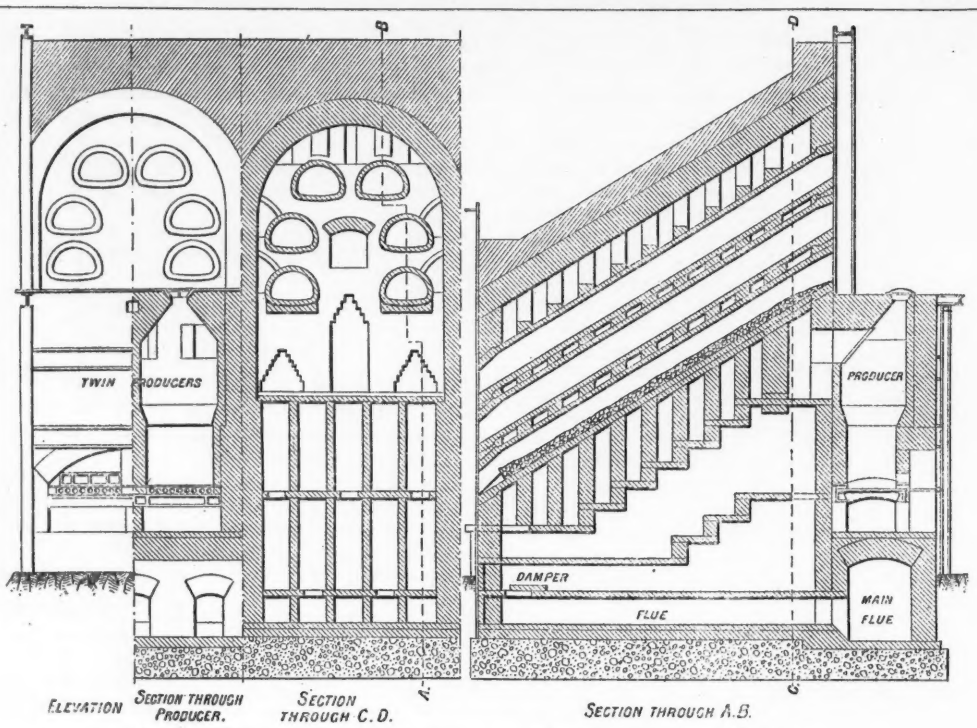


FIG. 5.—ELEVATION AND SECTION OF TERRACE'S RETORT-FURNACE.

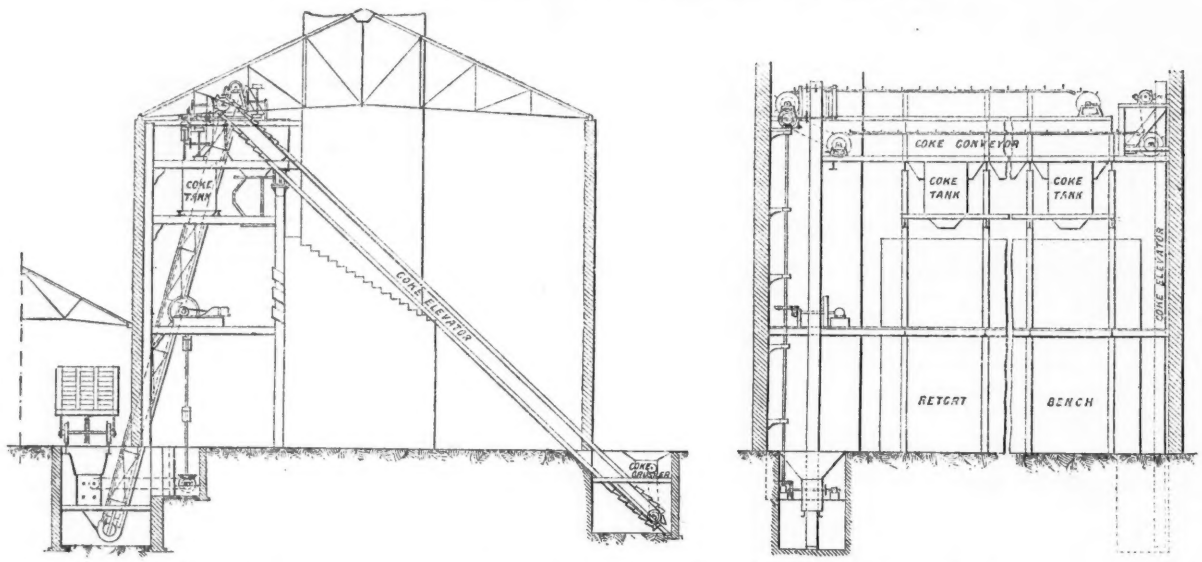


FIG. 7.—LONGITUDINAL AND CROSS SECTIONS OF COKE ELEVATOR, CONVEYOR, &c.

carbonize 7½ cwt. of coal per retort with six-hour charges, or 30 cwt. per day of 24 hours. With the 54 retorts, there will thus be carbonized 1620 cwt. of coal per 24 hours, or reckoning the 21 men employed, 77¼ cwt. per man. Each man is paid 5s. 3d. per shift, which is equal to 1s. 4⅓d. per ton of coal carbonized; and this, with (say) 1⅔d. for steam supply, sundries, &c., makes the total of 1s. 6d. per ton already referred to.

As to the quantity of fuel used, we found it took about the same as for similar systems of regenerative furnaces; but as the producers were charged with fuel, one-third of which was breeze, we were able to work them very economically. It is intended to try an internal producer, with which, if it can be as easily manipulated as the external ones, a still greater saving in fuel may be obtained.

Turning now to the diagrams of the complete system of inclined retorts which are at present being erected, you will observe that the coal is brought in trucks (fig. 4) into the store. The coals fall direct from the trucks to the brick trough, built over the coal-breaker (fig. 6). This trough holds a truck-load, and thus allows time for the attendant to push the truck when empty forward on the rails to be filled with coke, or otherwise, and bring up another full one. This trough also forms a supply hopper; and the necessary feed of coal is regulated to the elevator by adjusting the speed of the coal-breaker. This occupies a space about 3 feet square, and is fitted with four chilled-iron toothed rolls, as shown. The two top rolls are arranged to do all the preliminary crushing of the large pieces of coal; while the under pair, besides reducing the coal to the desired size, are arranged to act as regulating feed rolls. It appears that both pairs of rolls must be run at a differential speed—the top pair about 1 to 1½, and the bottom pair from 1 to 2½. If the rolls of a coal-breaker are run at equal speeds, the breaking power is greatly reduced; and the feed to the elevator, instead of being regular, is very intermittent. The coal—thus reduced, and practically made of uniform consistency—on passing from the breaker to the elevator-boot, is lifted by the buckets at the rate of 15 tons per hour to the steel-chain push-plate conveyor, fixed over the storeage-hoppers. The breaker and elevator possess a much greater breaking and lifting capacity when operated at the ordinary speed; but I prefer to run the machinery at a comparatively slow rate.

On fig. 1, you will notice that the conveyor is fixed over the nine storeage-hoppers, and distributes the coal to each and all in turn. The conveyor works entirely automatically, as the coal forms a natural bottom in the cast-iron trough when any of the storeage-hoppers are

full, and the supply is conveyed to the inlet-door of the succeeding hopper. The nine storeage-hoppers hold about 7 tons each; and the 63 tons which can be stored therein, is ample for the night supply. This obviates any necessity for running the elevating and conveying plant during the night-time. The storeage-hoppers are made of ¼-inch steel plate, stiffened with angle-irons, and carried on the transverse joists on the top of buckstaves, as shown. Under the coal storeage-hoppers, and attached thereto, are the measuring chambers, each of which holds the charge of 7½ cwt. for one retort; and you will observe by the drawings that only four of the chambers are necessary to command the six mouthpieces, owing to the method of setting.

The flow of coal from the large storeage-hoppers to the measuring chambers, is regulated (as shown on fig. 2) by means of top and bottom valves or slides, which are opened and shut alternately as the main-lever is moved. Inside each measuring chamber a hinged partition is fixed, worked by a quadrant which can be easily adjusted; thereby enlarging or diminishing the size of the chamber, and, of course, of the charge. The levers which open and close the valves or slides are fixed near the wall, as shown on fig 1.

Under the measuring chambers, the rails are fixed on which the portable charging-shoots run. Fig. 3 is a view of the portable shoot which conducts and regulates the speed of the coal from the measuring chamber to the mouthpiece of the retort; and A is an enlarged view of the regulator on the nose of the shoe. By this means, the coal is distributed evenly over the retorts. These are set at an angle of 32°; and we found this incline suit very well, as the coke, on being "tickled," easily leaves the retort. The coke when slaked is shot into a hopper over the coke-elevator, where it is broken and lifted to the conveyor fixed over the range of coke storeage-hoppers. These hold a full night's supply of coke for the producers. At the top of the coke-elevator a deflecting plate is hung, so that the coke may be conducted either to the coke-conveyor to fill the storeage-hoppers, or through a shoot direct to the railway trucks (see fig. 7).

From this description, the *modus operandi* followed in handling the coal and coke automatically will be clear to you, and only a few sentences are necessary—as the diagrams are self-explanatory—to point out the details of how the power is communicated to the coal-breaker, coal-elevator, coal-conveyor, coke-breaker, coke-elevator, and coke-conveyor. The motive power obtained is from a horizontal steam-engine with 10-inch by 20-inch cylinder; the crank-shaft of which drives the vertical shaft, as shown in fig. 7, by means of a pair of bevel-wheels 6 inches wide. The vertical shaft is 3 inches in diameter, and extends from the foot-step bearing to a height nearly level with the conveyors and the top of the coal-elevator. It is carried on the end wall of the retort-house by four side brackets and vertical pedestals. At the lower end, a pair of bevel-wheels are fixed to drive the short horizontal counter-shaft from which the coal-breaker is driven, by means of two sprocket-wheels and a patent detachable pressed steel chain. From the vertical shaft, two small counter-shafts are also operated; from the first of which the elevator is driven by two sprocket-wheels and a pressed steel chain, the second drives the coal-conveyor by spur-gearing, and also the coke-conveyer by sprocket wheels and steel chain. On the receiving end of the coke-conveyor, a sprocket-wheel is fixed on the spindle to drive the counter-shaft; and from this the coke-elevator is driven by another sprocket-wheel and steel chain. Motion having thus been given to the coke-elevator through the coke-conveyor, the coke-breaker is driven from a sprocket-wheel keyed on the lower spindle of the coke-elevator. With the malleable-cast or steel-cast chains hitherto largely used for conveyors and elevators, it would not have been feasible to take the power through the coke-conveyor to the coke-elevator, and from the latter to the coke-breaker; but with the new pressed steel chain now obtainable, however, there seems no danger of breakage, as the strain on the chain of the coke-conveyor, for instance (which has the most work to do) is not more than one ton, while the breaking strain of the chain is over 12 tons; thus providing a great margin of safety, and at the same time giving a compact, handy, and safe method of driving one machine through the other.

We will now consider the cost of this inclined retort system, as against similar horizontal settings with regenerative furnaces. Thus (approximately):

Inclined retort system—Per 20 feet through retort (with regenerative furnaces), including all machinery, cost about	£100
Horizontal retorts (with regenerative furnaces) each .	50
Difference being	£50
On which interest and depreciation has to be paid—say, on 54 through retorts, at £50 each = £2700 at 10 per cent. per annum	£270
Saving on 81 tons carbonized per day—Say, on 200 days = 16,200 tons, at 3s., less 1s. 6d. = 1s. 6d.	1215
Showing an annual gain of . .	£945

GAS POWER.

By J. Emerson Dowson, M.Inst.C.E.

No gas engineer can be indifferent to the great development in the use of gas power that has taken place during the last ten years. Thanks to the remarkable invention of the late Dr. Otto, and to the skill and enterprise of the makers of his engines, their popularity has been assured; and at the present time in Great Britain alone, the gas-engines sold represent something like 500,000 indicated horse power. If we assume that on an average only half the above power is in use for 1000 hours in a year, it represents a consumption of about 6000 million cubic feet per annum; and this at 2s. 6d. per 1000 cubic feet equals £750,000, or at 3s. £900,000 per annum. Truly, no mean result. And yet this has been attained with less aid or encouragement from the gas companies than might have been expected.

The gas-engine has made headway because it has certain marked advantages, compared with the steam-engine. No ground space for a boiler is required, and no chimney; there is no boiler to clean and repair, and no boiler insurance; there are no clinkers and ashes to remove, and no fireman to pay; the gas-engine can be stopped or started in a minute, and there is no loss of fuel during the stand-by hours. In fact, when an engine is worked with gas taken from the town mains, the conditions of working are almost ideal—especially as the fuel is strong, clean, and always ready for use, and as ample storeage of power is provided in the gasholder. These and other minor advantages have led to an extensive use of gas-engines; but, on the other hand, they have been seriously prejudiced, because the price of the fuel they for the most part have to be worked with is much higher than that of the fuel used for steam power. The makers of gas-engines are, in fact, obliged to admit that, when town gas costs more than 3s. per 1000 cubic feet, the working cost of an engine of more than 14-horse power nominal, exceeds that of a steam-engine of the same power, under the usual conditions of regular working. If, however, the price of the gas were 1s. 6d. per 1000 cubic feet, the result would be very different, even in localities where steam coal is cheap.

As is well known, the efficiency of an engine, whether steam or gas, depends chiefly on the proportion of the heat-energy of the fuel which it converts into work. This efficiency is mainly dependent on the difference between the initial and final pressures and temperatures developed in the cylinder, as shown by the indicator diagrams; and it is because this principle is now more generally recognized that modern steam-engines are worked with high pressure steam. In gas-engines, the initial pressure is more than double that usually adopted in steam-engines, and this at once gives the gas-engine a great advantage. Moreover, with steam power the steam must be produced in an independent boiler; and this must be large enough to produce a full supply and contain some in reserve. All the steam must be compressed in the boiler to the pressure required; and while under pressure, it must be conveyed to the engine—the loss from leakage and cooling being considerable. In the gas-engine, the working fluid can enter the cylinder with little or no pressure above that of the atmosphere; and if the gas is cooled on its way from the holder to the engine, it is an advantage, as each charge of gas which enters the cylinder is more dense, and consequently a given volume has greater energy. The mixture in the cylinder is compressed by the engine itself; and when the charge is fired, there is at once a great development of heat, and consequently of pressure. The difficulty, indeed, is not so much to get a high initial pressure, as to prevent its being excessive.

In his recent lecture at the Royal Institution, Professor Kennedy showed that a steam-engine cannot by any possibility convert into work more than 30 per cent. of the heat-energy put into the engine; that a hot-air engine may convert 50 per cent.; but an internally-fired gas-engine, as much as 80 per cent. The actual steam-engine of the best type converts about 10 per cent., and the actual gas-engine about 25 per cent.; so that, not only is the gas-engine far ahead of its competitor, but, what to my mind is infinitely more important, it has much greater possibilities of improvement. We see then that we are dealing with a source of power which science has proved to be sound in principle; we are not following a shadow, or trifling with a new phase of perpetual motion. As a practical result, the gas-engine has now fairly entered the field against steam; and in this very town of Belfast, gas power is to be used for the electric lighting stations.

This then is the infant prodigy of the engineering world, a child of great power and promise; but it needs to be fed and cared for, and let us see what its foster parents, the gas companies, have done for it. I am loth to say this, but, speaking generally, they have left it very much to the chance of its good looks and winning ways making a favourable impression on possible buyers. I believe there are about 1600 gas-works in the United Kingdom, but gas-engines are used at only 200 of them. In most cases, these engines are of 4-horse power nominal and under—several being of ½-horse power, and some less. There are only seven of 12-horse power, but five of 16-horse power, and none of larger size. Are we then to infer that the engineers and managers of gas-works are not yet convinced of the trustworthiness or economy of gas-engines?

As regards the price charged for gas, in my opinion it would be greatly to the advantage of gas companies, in most cases, to offer specially low rates for the gas used for engines, and to do all in their power to provide the necessary service-pipes. This is done to a certain extent in a few places; but in nearly all cases the net price is from 2s. 6d. upwards per 1000 cubic feet—Sunderland and a few other towns being notable exceptions. In Germany, much larger concessions are made for gas-engines; the reduction in price being from 20 to 47 per cent. in all large towns. It would certainly give a great impetus to the use of gas-engines, if the companies were able to sell gas at such prices as would admit of gas-engines in a particular district being worked at less cost than steam-engines, after allowing for saving of fireman's wages, &c. Where local boards or corporations are the owners of the gas-works, it may not be possible to supply any portion of the community at special rates; and some companies may be similarly restricted by their Acts of Parliament. But it would appear that in most cases it can be done. At all events, the subject is important and deserves consideration; and it is hoped that the high price of gas may not stand in the way of the full development of gas power.

This question is the more serious, because of the important part which the gas-engine is destined to play in connection with electric lighting. One of the sources of loss in a central station where steam power is used, is the consumption of fuel during the stand-by hours. Professor Kennedy and Mr. Crompton have both informed me that in their London central stations, where the load-factor is higher than in most other towns, the stand-by loss is about 10 per cent. of the total fuel consumed. In most other places, it is considerably more. Now, if gas-engines driven by town gas were used, the whole of this stand-by loss of fuel, as well as a proportionate amount for wages and other incidental expenses, would be saved; and at the same time there would be the certainty of always having an ample supply of working fluid ready for the engines, as the gasholder provides abundant storeage. This subject is now being seriously discussed by electrical engineers; and, as Professor Forbes remarked at the Institution of Civil Engineers, the other day: "Electrical engineers are on the verge of having to consider cases in which it is more economical to use gas for distributing power to sub-stations, than to spend money in the street feeders." Mr. James Swinburne was among the first to urge the use of gas-engines for central stations; and in the case of Belfast, Professor Kennedy has shown his belief in them.

The interest of gas companies, is not, however, limited to the use of gas; they also have to find a market for the coke they produce, and often have to spend much in advertising it. In some places, especially those in which coal is cheap, the disposal of large quantities of coke at remunerative prices is often attended with difficulty. Coke is not suitable for the heating of steam-boilers; but it can be converted into gas in the plant I have introduced, and gas so made can be used for driving gas-engines. The coke for this purpose should be clean (not mixed with small coal or yard sweepings); and it should be in pieces about 1 to 1½ inches cube. The best fuel for my generators is anthracite, as it forms a close fire, it does not cake, it needs no stirring, it contains a small percentage of sulphur, and it forms little clinker. It is, however, necessary that the gas-engine and plant should be able to compete favourably with the steam-engine and boiler in all places. With anthracite, this is not, of course, always possible; and where it cannot compete with the local price of steam coal, there is the opportunity for coke. If, however, the supply of coke is not facilitated, means will certainly be devised for making suitable generator gas with bituminous coal. Ever since large gas-engines have been made, and have been competing with steam, I have felt that it would be profitable for gas companies to sell small coke at prices under those of anthracite, and which would admit of gas-engines competing favourably with steam. In several cases, however, the gas companies have shown no disposition whatever to meet the case. They would not break the coke to the size required, so that the consumers have had to buy and work mechanical crushers; nor would they make the slightest concession in price. In Belgium and Germany, it is not unusual to wash the small coke; and if the breeze of our gas-works were treated in this way, a most profitable branch of business might be established in connection with gas power. It might be added that, as the number of small and medium sized engines increases, as it must do, more town gas must be made; and there will be more coke. This difficulty can, however, be removed by the conversion of coke into generator gas, for engines too large to be driven economically with town gas.

In a paper of mine on "Gas Power for Electric Lighting," which was read recently at the Institution of Civil Engineers,* numerous examples were given of engines working with my gas; and I will not repeat them here, as the Proceedings of the Institution can easily be referred to. I may, however, quote the following examples of engines working with my gas made from coke:—

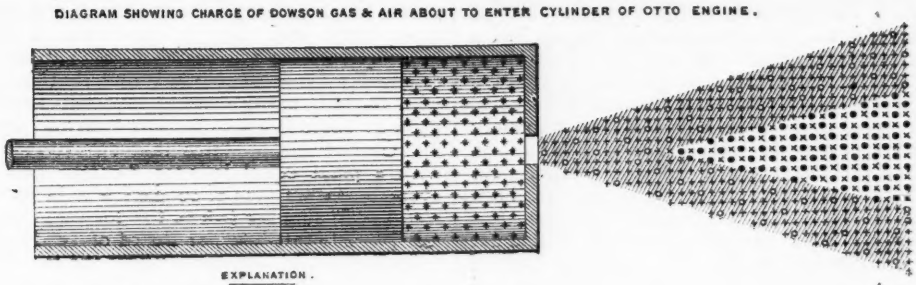
Date when Started.	Locality.	Name of User.	Total Indicated Horse Power.
1889 October .	Beverley .	T. W. Marshall	35
1890 February .	Rushden .	Cave and Sons.	80
„ September	Elswick .	Armstrong, Mitchell, and Co.	250
1891 March . .	Halifax. .	Carter and Co.	180
„ April . .	Newtown .	Severn Tweed Co.	300
„ August .	Ettingshall.	Holcroft and Co.	110
„ November.	Sandiacre .	Wells Brothers.	35
1892 April . .	Shipley. .	Cundall and Sons.	45
„ December.	Heywood .	Healey Brothers.	80
1893 February .	Malton . .	Farmers' Manure Co.	80
„ May . .	Halifax .	Fredk. Smith and Co.	400

All who are conversant with the leading gas-engines in use, know that they have been greatly improved and simplified during the last four or five years. The consumption of gas per horse power has been sensibly reduced; there are now no troublesome slide-valves to keep in order; the nuisance from the noise of the exhausts has been nearly overcome (a point of importance in large engines); starters have been introduced; and in other ways practical difficulties have to a great extent been disposed of. Now, however, that engines of large size are coming to the front, there are points which still deserve special attention.

In the first place, it is well known to most that in a gas-engine it is not possible to raise the power developed beyond a certain maximum, without increasing the speed. With steam it is different, as the boiler pressure can be raised on an emergency; but if more gas or more air is put into the cylinder of a gas-engine, there is necessarily a diminution of the power developed. In a factory where the load varies considerably, the buyer of the engine often under-estimates the horse power required; and he does not always realize that he cannot raise the power of gas-

* For an abstract of this paper, see JOURNAL, Vol. LXI., p. 100. The full text of the paper appeared in the Minutes of Proceedings of the Institution, Vol. CXII., Part II.

DIAGRAM SHOWING CHARGE OF DOWSON GAS & AIR ABOUT TO ENTER CYLINDER OF OTTO ENGINE.



EXPLANATION.

●×● Charge of Dowson Gas } to enter Cylinder on outstroke of Piston.
○+++○ Charge of Air }
● Combustible Gas, (Hydrogen & Carbonic Oxide.)
× Incombustible Gas, (Nitrogen & Carbonic Acid.)
○ Oxygen.
+ Nitrogen.
* Products of combustion left in compression Chamber at end of Exhaust Stroke.

engines, as he knows he can do with steam-engines. Even if he does realize this, he is tempted by the higher price of gas-engines to have as small a one as possible. With small engines, the risk is not great, as they can be exchanged for larger ones without great expense; but where large engines are concerned, even a small increase of power may be attended with much difficulty.

A further point is that, as large engines cannot be worked economically with town gas, they must be worked with some such fuel gas as that made in my apparatus. But the gas made in a generator must necessarily fluctuate a little in quality, owing to the varying condition of the fire, and the varying pressure of the steam required for the injector; also some allowance should be made for the possible negligence of the fireman. To a certain extent, this can be met by the diffusion of gases of varying strength in the gasholder; but for large powers, we cannot depend on this for uniformity in quality. About 80 cubic feet of my gas made from coke are required per indicated horse power per hour, so that for 100 indicated horse power we require about 8000 cubic feet, or for 500 indicated horse power 40,000 cubic feet per hour; and the difficulty of cleaning and cooling so large a volume of gas, to be used as quickly as it is made, is sufficiently great, without adding to the plant a costly holder of large dimensions. I have always considered that, from a practical point of view, we must be able to feed one or more engines without having recourse to a large storeage of gas. In fact, with a well-designed plant, we should no more require storeage of gas for a gas-engine than we require storeage of steam for a steam-engine. I have succeeded in doing this; and the gasholder in my plant for 100 indicated horse power is 8 feet diameter by 8 feet deep, and contains only 400 cubic feet. It works perfectly well; but it involves a consideration which will presently be referred to.

The gas made in my apparatus has about one-fourth the explosive force of ordinary town gas; so that to develop a given power four volumes of mine must be used, instead of one of the other. It is true that the generator gas requires much less air for its combustion, so that in an Otto engine it is possible to introduce gas enough in the cylinder to secure nearly the maximum horse-power obtainable with town gas. It is, however, in my opinion, distinctly wrong to dilute the comparatively weak generator gas with a large proportion of residual products, as in the Otto cycle. The generator gas contains a large proportion of nitrogen and some carbonic acid; and if it is remembered that about four-fifths of every volume of air admitted into the cylinder of an engine consists of nitrogen, it is not difficult to imagine that it is no easy matter for individual molecules of oxygen to come into contact with the molecules of hydrogen and carbonic oxide. It is not possible to show in a diagram what actually occurs during the admission and compression of a charge of gas and air; but the accompanying diagram may serve to indicate the relative proportions of the air, gas, and products of combustion which have to be mixed together. Even without considering the influence of the residual products, it is as though there were two contending parties in the charge of gas and air; four-fifths of one party endeavouring to prevent the remaining fifth from joining half the members of the other party, the other half of which is opposed to the union. Then when the charge of gas and air enters the cylinder, and is mixed with a considerable volume of residual products, the combination of the oxygen with the combustible gases is rendered still more difficult. Apart from these difficulties, there remains the fact that carbonic oxide is slower to ignite than hydrogen—doubtless because the carbon has already partially satisfied its affinity for oxygen. Hence, more than half the combustible constituents of generator gas are inherently slow to ignite; and as this slowness of ignition is made worse by the presence of residual products, it is necessary to use a higher compression for a charge of generator gas than for ordinary town gas, so as to bring the molecules closer together.

All this tends to show that generator gas—or any comparatively weak form of gas—should not be diluted with residual products; and that no more air should be introduced than is necessary for the complete combustion of the charge. I urged this point in my recent paper at the Institution of Civil Engineers; and I was glad to find that all those who referred to the subject, in the long discussion which followed, endorsed my opinion. It was generally accepted that the removal of the products was right in principle, and that the question resolved itself into one of devising means of carrying it out in a good mechanical way. Briefly stated, the scavenging of the products has the following advantages:—

(1) The firing of the charge is more prompt; and the combustion is more complete.

(2) There is less loss of power when the quality of the gas is not of the best.

(3) The trouble with late explosions and pre-ignitions is almost entirely avoided.

(4) When a considerable volume of hot products is left in the cylinder, the engine itself is more heated; and for this reason, and because it mixes with the residual products, the new charge is more expanded, and therefore a given volume contains less energy.

(5) It is not possible to have an explosion of greater force than is required to develop the maximum horse power intended. In the Otto engine, if from any cause the charge is not fired, there is a still stronger charge to fire after the next intake of gas; and the pressure developed after the explosion is excessive.

(6) The pressures of successive explosions being more uniform, there is steadier running.

(7) The strains on the engine after a misfire are less severe.

(8) The loud noise now caused by the excessively strong explosion which follows a misfire is avoided.

(9) If there is a motor cylinder and a pump cylinder, there can be an impulse every revolution in a single-acting engine, and an impulse every stroke in a double-acting engine.

(10) An engine of given size will develop more power.

It will now be seen that, if the generator gas is treated properly in the engine, so as to get the highest possible duty out of it, and so as to insure uniform results, there will be no need to provide specially for the slight fluctuations which may occur in the quality of the gas. Mr. Atkinson has proved this incontestably in his ingenious

engine, in which the products are scavenged out. I understand that Messrs. Wells Bros. have also applied a scavenging arrangement to an Otto engine, with excellent results; and that they are able to get steady running with gas of inferior quality made from some poor coke. It will also be seen that, when a gas-engine is to work with generator gas, it may be depended on to give uniform results, provided the engine is of suitable design. No one knows better than myself that the Otto cycle has been most successful for moderate powers, and it will doubtless continue to be so; but let us realize that this is due not so much to a dilution of the gas with spent products of combustion, as to being able to draw in, compress, and fire the charge in one and the same cylinder. Let us also realize that with generator gas this cycle is a vicious one; and that, although good results have been obtained with it, the difficulties are greater than they should or need be. Large engines depend on gas of this kind for economical working. It is therefore essential that they should be designed for the cheap fuel gas, and should not be made for town gas—which is too costly to use—and then be worked with generator gas, as a kind of makeshift.

I do not wish to exaggerate the importance of the smoke nuisance with steam power; but the subject of this paper would not be complete without some reference to it. I have ascertained from several leading coal merchants, that the consumption of coal for steam power in the London district is over 5,000,000 tons per annum, exclusive of that used on the railways and steamboats. Assuming that three-fourths of this are burnt in the day-time, there is a consumption of about 1500 tons of coal per working hour for steam power, and supposing that this contains an average of only 80 per cent. of carbon, it represents about 4400 tons, or something like 80 million cubic feet of carbonic acid per hour—to say nothing of carbonic oxide, sulphurous acid, and smoky hydrocarbons. If an average of 5 lbs. of coal per horse power per hour be assumed, there is a total of 672,000-horse power hours; and allowing a general average of 30 lbs. of water per horse power, there are 9000 tons, or something like 400 million cubic feet of exhaust steam, discharged into the air of London every hour.

With gas power derived from my generator gas, there is not more than half the coal or coke to burn, and therefore only half the quantity of carbonic acid to be given off. The steam evolved from the oxidation of the hydrogen amounts to some 13½ cubic feet, or about 6 lbs. per indicated horse power per hour—*i.e.*, about 2 per cent. only of that required for a steam-engine using 25 lbs. per horse power. Broadly stated, the volume of exhaust steam and products of combustion inherent in the working of steam-power plant, is reduced by 90 per cent. when gas power is used; and though some persons may think this of little consequence, I venture to say that it is worthy of attention—especially if we are to suppose that the lighting of large areas of our towns is to be done with electricity, requiring as it does such a large absorption of power.

I have already referred to the advantages of gas power for the production of electricity. I will now go a step further, and ask you to consider whether it will not in many cases be advantageous for gas companies to undertake the supply of electricity in certain selected areas of the districts over which they have control. I am aware that there may be difficulties in obtaining the necessary parliamentary powers to do so. But these difficulties are not insuperable; and the question of first importance is to see if it will be advantageous for gas companies to supply electricity produced by gas power.

In this connection, I may refer to a point of considerable interest. So long ago as 1878, Dr. John Hopkinson called attention to the fact that, when ordinary town gas is burnt in a gas-engine to drive a dynamo, much more light is produced electrically than can be produced by burning the same quantity of gas in burners in the usual way. In 1879, the late Sir William Siemens stated in evidence before a Select Committee of the House of Commons, that with a dynamo driven by a gas-engine 19·5 cubic feet of 18-candle gas produced an arc light equal to 1000 standard candles; whereas 312·5 cubic feet of gas would be required to give the same light in Argand burners. Since that time, the consumption of gas per horse power in engines of larger size has been considerably reduced; and it is not too much to say that the ratio is now 20 to 1 in favour of converting the gas into an arc light, by means of a gas-engine. At the period referred to, the glow lamp was not in use; but I have obtained information from various sources as to the consumption of gas for glow lamps, and find that in average work, with engines under varying loads, it varies from about 34 to 47 cubic feet per kilowatt-hour of current delivered. Mr. Gisbert Kapp states that at Tussaud's Exhibition, with a plant equal to 1500 8-candle power lamps, the average consumption of 18 days was in winter 33·4 cubic feet, and in summer (when the load was lighter) 36 cubic feet per kilowatt-hour, or Board of Trade unit.

At Dessau, in Germany, where the Gas Company have an electric lighting station with gas power, the consumption of gas, taken over an average of thirty days in December last, was 40·82 cubic feet per kilowatt-hour generated at the terminals of the dynamos. A full account of this interesting installation will be found in the JOURNAL OF GAS LIGHTING for Jan. 5 and 12, 1892; and there is a further reference to it in that publication for April 4 and 11 last. I visited Dessau last autumn; and it is through the courtesy of the Managing Director (Herr W. von Oechelhäuser), that I am able to give you the above results. In this country, it is usual to allow 60 watts per hour for a 16-candle power lamp; but on the Continent, it is more common to allow only 3 watts per candle power, or 48 watts per 16-candle power lamp. At Dessau, the actual consumption is under this. If, however, we take the English allowance of 60 watts to give the light of 16 candles, and if 41 cubic feet of gas are consumed to produce 1000 watts as at Dessau, one of these lights will require under 2½ cubic feet per hour; whereas a standard Argand burner requires 5 cubic feet, and an ordinary flat-flame burner considerably more. We see, therefore, that in actual working there is a saving of 50 per cent. in favour of burning the gas in the engine, and in producing the light electrically in glow lamps.

If an exact comparison were made of the actual light obtained by consumers under the average conditions of daily use, it would probably be found that the saving would be still greater. Mr. Vernon Harcourt, in conjunction with Mr. Preece, made careful experiments at the General Post Office, to determine the average illumination from the gas-burners in use; and it was found that with 16-candle gas the ordinary burner gave only 10-candle power, when consuming gas at the rate of about 5 feet per hour. This falling off in light was believed to be due partly to dirt in the burners, but chiefly to the flickering of the flames, caused by draught in the rooms. As regards the electric glow lamps, it is well known that after some months' use their light is dimmed by volatilized carbon deposited on the glass bulbs. But so long as they remain efficient, they are not influenced by draughts or atmospheric conditions; and when the lamps are eventually spoilt, they are renewed at the consumers' cost.

So far, therefore, as the gas companies are concerned, it is clear that, with a given quantity of gas, they can produce much more light electrically; and the question will naturally be asked: Is it worth while to incur the cost of electrical plant, to effect this saving? Such a question cannot well be answered in a general way; as in each locality there are special conditions to take account of. One of the principal items of cost is the electrical mains; and this depends very much on whether the houses to be supplied are scattered or concentrated. The selling price of the gas with which the electric lights will have to compete, is also an important factor. It is, however, clear that, if an independent electric lighting company can work at a profit, a gas company under ordinary conditions can work at a greater profit. The independent company must have a separate administration, and a complete staff; whereas the gas company will need but a comparatively small addition to its existing staff. I am informed that at Dessau—which is in a quiet, agricultural district—the average number of hours during which each glow lamp is used is only 264 in a year; and that, notwithstanding this, the gas company is earning 5 per cent. on its capital outlay for the electrical plant. There is, however, another point to consider; and that is that, by having small electrical stations in the heart of the best neighbourhoods, gas companies can keep away competing electric lighting companies, and can retain many consumers who would otherwise be served by the independent companies. In other cases, it may be best to have a central station in the gas-works or elsewhere,

with engines worked by gas made from coke in my apparatus.

I venture to think that many gas companies will find these suggestions worth consideration. Electric lighting is no mere fad—it has come to stay, and to grow; and although gas engineers would rather be without it, they know well enough that the world will go ahead, and have what it believes to be best, and what it prefers. If this fact is realized, it seems but prudent that the gas companies should adapt themselves to the altered circumstances, and consider how they can best secure to themselves increased custom; although part of what they may have to sell is not gas, but a product of gas power.

It is well known that, in most towns, the leading shopkeepers, the hotel keepers, and proprietors of theatres and other public places of resort—to say nothing of banks and offices—would gladly have electric lights instead of gas, even if it were rather more costly. In many towns, the change has already been effected; and there are sure indications that the movement is extending. But I do not infer from this that the gas companies must necessarily be losers; on the contrary, I think there are several ways in which they can turn the change to profitable account. We should remember also that the introduction of electric lights has undoubtedly made the public generally more appreciative of bright lights; and that this has led to an increased consumption of gas, not only for lighting streets, but for shops and dwellings. I have already suggested that in many places gas companies can keep out troublesome competitors, and at the same time earn profitable returns, if they supply electricity in well-selected areas. I make this suggestion, however, on the supposition that the gas companies adopt gas power for the generating stations; the gas being the ordinary town gas, or generator gas, such as is made in my apparatus with ordinary gas coke. Where it is not practicable for a gas company to supply electricity, special inducements should, I think, be offered to the electric lighting company to adopt gas power for its stations; the gas for the engines being offered at a low rate. Failing this, the electric light company might be urged to use generator gas made from coke of the gas-works.

The best instance of town gas being used for electric lighting on a large scale is at Dessau; and in all probability Belfast will be the next to follow, although there are several other places where the subject is under consideration. At Morecambe, on the Lancashire coast, there is an installation of some interest. A small central station was started by an independent company about a year ago; and at first three 16-horse power nominal Stockport engines were worked with town gas. But as the price charged for it was 3s. 3d. per 1000 cubic feet, my generator gas was afterwards adopted. The price of the town gas to ordinary consumers is 3s. 11d. per 1000 cubic feet, and the electric current is sold on the basis of an equivalent rate, light for light. An 8-candle power glow lamp is treated as equal to a 4 cubic feet burner; and several consumers say that the electric lights are more economical—probably because they are turned on and off just when required. The applications for current have increased, so that a 30-horse power nominal Crossley engine has just been added; and a further one of 60-horse power nominal will be fixed as soon as it is made. The part of the town near the central station is served with a low-tension (115 volts) continuous current; and the western extension of the town—distant about a mile from the station—is about to be served with a moderately high tension (1000 volts) continuous current. At the west-end of the town, there will be a transformer, to reduce the current pressure to 115 volts; and by an ingenious device of Mr. T. Preece, the Electrical Engineer of the Company, the current from the transformer will be regulated automatically, so that there will be no need of an attendant to regulate the transformer. I cannot help thinking that the Morecambe Gas Company would have done well to supply the electric lights, or to have sold gas for the engines at a reasonable rate. By not following either of these courses, they have not only lost many customers, but will doubtless lose many more.

In conclusion, I beg to summarize briefly the leading points to which I have referred:—

(1) Gas power should be used at gas-works instead of steam power.

(2) Town gas should be sold at specially low rates for gas-engines.

(3) Small coke, clean and of good quality, should be sold for Dowson generator gas, at such prices as will compete favourably with steam coal and with anthracite.

(4) Makers of gas-engines should be urged to scavenge out the products of combustion in all engines working with coke gas, and in large engines with whatever gas is used.

(5) Gas companies should consider the desirability of supplying electric lights in selected areas of the districts they control.

(6) For this purpose, they can have gas-engines worked with town gas in the heart of the areas to be supplied, or they can have a central station at the gas-works or elsewhere, and have engines driven by coke gas.

(7) When gas companies supply electric lights, they should use gas power, and not steam power.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 43.)

One idea has dominated all others during the past week; and the pivot upon which everything has turned has been Silver. This long-vexed question having been at length brought to a head by the closing of the Indian mints, the price of the metal fell so sharply and so rapidly that "panic" is not too strong a word to describe the position on Friday. That silver could ever be bought for half-a-crown an ounce would once have seemed an impossibility; yet so it was on that day. Happily a smart recovery set in the next day. The result of this fall was not only to greatly depress the market for every security having any affinity with silver, but to upset prices in general. What the ultimate effect may be, it is wholly impossible to foresee; opinions which are entitled to great weight being completely at variance. Meanwhile, it is satisfactory to be able to note that the Gas Market has not been a sufferer. It is true that there are one or two slight retrogressions, as well as improvements, in quotation; but they are rather recoils from previous advances, and by way of realization of profits. On the whole, prices have been fairly well maintained; but business was not very brisk. An average amount was done in Gaslight "A" at steady figures through the week, although the quotation was put down 1 lower. More than an average amount was done in the secured issues; and prices were satisfactory, although no advances were scored. A few transactions were effected in South Metropolitan "B," which remained stationary, while the "A" advanced, and now once again figures at 300 and upwards. What business was marked in Commercials gave evidence of strength. Among the Suburban and Provincial Companies, Brentford old improved; but buyers of British offered a point lower. The Continental undertakings were extremely quiet; and prices of Imperial and European were easier. None of the rest scattered farther abroad presented any feature of interest. Business in the Water Companies opened very brisk, but soon quieted down into the usual degree of inactivity; and the only variation in the quotations was a fall in East London.

The daily operations were: The Gas Market opened unchanged on Monday. Business was moderate; and prices remained level. Buenos Ayres was quoted closer at ½ margin. Transactions were much more restricted on Tuesday; and movements were variable. Brentford old rose 2; but Gaslight "A" and Imperial Continental fell 1 each. In Water, East London was 2 lower. Wednesday's business was about on a par with the preceding day. European receded ½. Thursday brought no revival of activity; but what securities were dealt in fetched good figures. South Metropolitan "A" stock advanced 1; but British receded ½. Friday was a more active day, and prices were well sustained; but the only variation was an advance of 2 in South Metropolitan "A." East London Water receded 1. Saturday was very quiet, as usual; and all quotations closed without further alteration.

ELECTRIC LIGHTING MEMORANDA.

The Select Committee on Electrical Disturbances—The Accounts of the London Electric Supply Companies—Garbage Destruction and Electric Lighting at St. Pancras—How the Money Goes.

The Select Committee on Electrical Disturbances have completed the taking of evidence, and we shall probably be in a position next week to discuss their report. In the meantime we are giving elsewhere so much of the evidence as relates to the gas and water part of the question, and are confident that the Committee will deal properly with these interests. Indeed, the attitude of the electricians with regard to this part of the case was conspicuously fair, and deserves recognition.

Dr. John Hopkinson admitted that the danger to gas-pipes from leakage of return currents is of a serious nature; and he was corroborated by other authorities. The *Electrician* also confesses that the interests of the gas and water companies are seriously threatened, but believes there is no obstacle in the way of their adequate protection. Perfect insulation of return cables, and the abandonment of the use of tramrails, tunnel casings, and other makeshift means of completing the circuits, will probably answer the purpose; but the development of the use of high-tension currents will need careful watching in the future. In another part of the present issue of the JOURNAL will be found an illustration of what happens to gas-pipes when these strong currents are allowed to make their way to "earth" promiscuously. It is imperative that electrical tram and rail roads should find some other means of carrying on their work, that does not involve the destruction of all the gas and water pipes in the same town. Once more our American friends have shown us what to avoid.

The number of the *Electrician* for the 23rd ult. contains an analysis of the accounts of the London electricity supply companies for last year, based upon the Board of Trade returns. Ten undertakings are comprised .n the analysis. Commenting upon these figures, our contemporary remarks that, with but one exception, the companies have furnished it with statements of their outputs as determined by station meters; and these together make an aggregate of 7,915,746 units, as compared with about 4,300,000 units for the previous year. This is an increase of 84 per cent.; while the rental has increased from £143,992 to £225,790, or a rise of 57 per cent. Exact comparison of the working of the different companies is rendered difficult by the prevalence of different ideas among them with regard to the apportionment of charges. The money actually spent on capital account by the ten listed undertakings—the City of London Company not included—amounts to £2,536,052. The ration of (admitted) expenditure on revenue account ranges from 51·6 per cent. in the case of the Charing Cross and Strand undertaking to 116·12 per cent. in that of the unfortunate London Electric Supply Corporation. The total expenditure per unit sold ranges from 3·8d. to 10·7d.; the highest cost being incurred by the Notting Hill Company. The coal consumption per unit supplied varies from 0·92d. in the case of the Kensington and Knightsbridge Company, to 2·36d. in that of the London Electric Supply Corporation. The Westminster appears to be coming to the front as an example of a well-managed concern; yet in this case salaries and wages are more than the cost of coal, and together with management expenses amount to 58·4 per cent. of the generating charges.

A joint report has been presented to the St. Pancras Vestry by their Electricity and Public Lighting and Special (Dusting and Slopping) Committees, upon the combined questions of the collection of house and street refuse, the burning of such refuse, and the utilization of the heat so obtained for the generation of electricity. The report concludes in favour of this combination. The Committee consulted Professor Henry Robinson and Mr. Blair, the Borough Engineer and Surveyor of the Vestry, and a scheme has been prepared by these gentlemen which comprises the erection of eighteen destructor cells in connection with a new electricity generating station capable of supplying 4800 lamps. The Lancashire boilers of the station are to be heated by the gases from the destructor cells. The plant for dealing with the refuse is estimated to cost £19,000; and a saving of 1s. 3d. per ton is expected on the refuse dealt with, irrespective of the value of the heat and any revenue derivable from the mortar, &c., produced from the clinkers. The immediate cost of the electric supply station is estimated at £30,900. The report is an interesting indication of the way in which a Local Authority, having gone in for electric lighting, are apt to be led from one step to another; and the experiment, if it is carried out, will be interesting in an engineering sense. The saving, however, will be only in the scavenging account; for it is very doubtful if an electric light station that would not pay otherwise can be rendered a profitable investment, even if the fuel costs nothing.

In connection with the last application of the Brighton Town Council to the Local Government Board for permission to raise additional capital by borrowing for the purposes of electric lighting, some interesting statements were made as to how the money goes in adventures of this kind. The first loan sanctioned was for £32,500, which was soon spent, and £8500 more was borrowed two years later. Then a sum of £37,700 was wanted; and this was also obtained at the beginning of the current year. Now another £8200 is asked for, to make up ascertained deficiencies, which arose in this way: The buildings were estimated to cost £3000; and they, in fact, cost £5059. The generating plant was to have cost £8000; whereas it actually cost £10,079. The instruments were originally estimated at £800, and afterwards at £800 more—making £1600 in all; and they actually cost £82 more than this. Mains and services, which were to have cost £16,900, ran into £20,673; and besides there were various incidental expenses for which it was found that no provision had been made—such as plant for lighting the station, £200; engineer's commission, £1496; clerk of works, printing, advertising, &c., £305; and certain other "contingencies" which exceeded the estimate by some 50 per cent. It is evident that a large margin must be allowed for in cases of this nature.

THE BELFAST GAS-WORKS.

WHEN The Gas Institute meeting was in progress in Belfast, it was natural for the members to feel an interest in the gas undertaking under the control of Mr. James Stelfox, the actual condition and future of which have been so warmly canvassed by parties in the Corporation and the City. It will be remembered that the Gas Commissioners, who are responsible for the supply of this necessary of life to the town and district, were confronted many years ago—put it at ten, for the sake of clearness—with the impossibility of continuing to rely upon the existing gas-works in the Ormeau Road for keeping pace with the ever-increasing consumption. The old Company handed over to the Commissioners a compact manufacturing establishment, which had served their time, but which they themselves would have been obliged to supplement with a second station if they had continued in existence much longer. The property, and the responsibility for the supply, however, passed to the Local Authority—or, to be exact, to a specially-elected body representing the public interest in the undertaking; and with the adoption by this body of a thorough-going popular policy, the gas consumption grew enormously. Mr. Stelfox threw himself heart and soul into the new style of administration; and the Belfast gas undertaking rapidly improved its position as one of the most flourishing of the many thriving industries of the commercial capital of Ireland.

To do him justice, Mr. Stelfox warned the Commissioners betimes that additional works would be necessary; and he indicated the direction in which this expansion could be most easily, unobjectionably, and economically made. It so happened, however, that at this period—ten years ago—the electricians were making a great noise in the land, and prophesying the speedy end of the gas industry in Belfast and everywhere else. The good burgesses of Belfast, among their manifold virtues, do not appear to include that of seeing a joke of this kind. They took the electricians seriously, and were afraid to launch out into such a bold scheme of gas-works extensions as the South Metropolitan Company of London were at the very time embarking upon. Time slipped away, the old works were stretched here and filled in there as need arose, at enormous expense and inconvenience; but no move was made in the direction ceaselessly pleaded for by the responsible Engineer. The Commissioners failed to realize the principles then being illustrated by Mr. George Livesey, who was proving, in the case of the East Greenwich station, that a properly-considered scheme of gas-works extension, undertaken betimes, and carried out with due reference to the requirements of the period, entails no burden upon the undertaking as a whole, but is supported by the extra profit accruing from new business as compared with the old consumption. So the Belfast Gas Commissioners lost time, which in this case is truly money, until matters came to a climax, and their Engineer threw upon them the whole responsibility for any such collapse as might happen to the best-managed gas-works, when every retort is in use for weeks together in the depth of winter, and there is no room for more.

Then the Commissioners plucked up heart and declared for a new works; but where? The answer only plunged them into a deeper quandary—deep as the bog upon which so much of Belfast stands. The existing works occupy a site between the tidal river and the Ormeau Road, hemmed in, moreover, by railway property. Just across this river lies the Ormeau Park, the portion bordering the foreshore being low, swampy, and useless for any of the ordinary purposes of a recreation-ground for six months of the year. Taken as a whole, however, the Park is a valuable pleasance for Belfast. It belongs to the Corporation, who reserved a considerable area of the higher-lying portion, at a distance from the gas-works, for building sites, the return from which they expected to partly recoup them for their outlay on the property. This expectation has not been fulfilled, probably for the reason that well-to-do people prefer to live out of Belfast altogether, instead of lending themselves to the improvement of the Corporation property.

Here, in the swampy, low-lying, semi-useless part of the Park, Mr. Stelfox first, and ultimately the Commissioners, saw the right spot for the necessary gas-works extension. In return for it, the Commissioners offered to buy the reserved portion already mentioned, at a fancy price, and throw it into the pleasure-grounds. This would be a very good bargain for the Corporation, as well as a boon to the people. Ten years ago the transaction might have been completed out of hand; but now a difficulty has arisen. The cry has been raised that it is proposed to take the Park away from the People (spelt with a large capital), and appropriate it to gas making; and the great heart of the local public has been stirred to its core over the contemplated sacrilege—mainly, of course, by the newspapers, who find in the subject a pleasant relief from the exiguous political polemic in which they are usually sunk.

The opinion of Mr. Stelfox with regard to the suitability of the Ormeau Park site has been supported, as our readers are aware, by the independent testimony of Mr. Corbet Woodall and Mr. William Foulis. There is practically no alternative site, except in the melancholy morass lying between the city and the lough, to which coals could be brought. This slough can only be built upon at fabulous cost; and even then there is no security against settlements that would be fatal in a gas-works. It is simply semi-fluid mud, with all the vices of a

quicksand of practically limitless depth, added to slipperiness, filthiness, and eccentricity of movement all its own. Of course, if the citizens of Belfast will that their gas should be made on such ground, they can have it so, at a price; but they will have learnt from the example of their new sewerage works what this price is likely to be.

All this introduction is necessary to a profitable inspection of the actual Belfast Gas-Works, the chief interest of which is, in point of fact, external and inferential. It is not so much what the works can do that is of the greatest gas engineering moment, but what they cannot do, and where they must prove insufficient. To begin with, there is a handsome suite of offices and a line of other buildings forming a long front to the Ormeau Road, which testify to the desire of the Commissioners to save themselves from the reproach of spoiling the appearance of the thoroughfare. These front buildings, and all the other structures in the works which admit of ornate treatment, such as engine and meter houses, are standing proofs of the liberality of the Commissioners, and an evidence of the pride they take in their fine property. Walls inlaid with pitch-pine and stained-glass domes are not, perhaps, strictly necessary to the correct working of a station meter. But there are different styles of doing things; and Belfast does its work in the grand manner. The first and last impression received by a visitor who walks through the yard and round the retort-houses and plant is that of close packing. A crowded works means, to the engineer, trouble with connections; and Mr. Stelfox has had to use his best wits to get his gas into and out of the indispensable apparatus, besides finding room for the apparatus itself. One fruit of this study is a concentric crossing-box, which saves a good deal of space, and is largely used in these works.

The original plan of the station was to have everything in duplicate. It is, in fact, a double works; the centre being marked by a coke road, and on either hand being the retort houses, which send their independent streams of gas to the right and the left, to be treated by their own proper exhausting, scrubbing, and purifying plant. There is not much reason in this duplicate idea, which does not correspond to any real requirements of gas manufacture, and only represents an imaginary safeguard. On the other hand, it runs into ground space; and we have no doubt that if the Belfast Gas-Works were to be cleared away, and the site laid out anew, it would be possible to get more gas out of it than the present design affords. But this, of course, is impossible. As it is, the coke and coal overflows into the retort-house doorways; and every piece of apparatus jostles its neighbour. The principle that live mains should never be buried out of reach, for instance, is necessarily set at naught in the preparations for a new 250,000 cubic feet meter, by the Gas-Meter Company, which must stand right over a main buried in concrete.

There is a good sale for coke in Belfast, which necessitates keeping a stock; and although this is stacked high by means of a crane, it is difficult to find room for it. The latest attempts to make the station productive in the highest possible degree are expressed in the adoption of the Claus purifying plant, a set of Humphreys and Glasgow's water-gas plant, and a new retort-house to be worked by West's most improved machinery. The West machinery and appliances have already stood the Belfast people in good stead; and if they had not been reliable under the strain involved in bringing every ton of coal from one corner of the site, and getting it into the retorts, the works would have failed the town long ago. Dealing with these novelties in the order given, we find that the Belfast Claus plant consists of a set of five coke scrubbers, each 12 feet diameter and 50 feet high, devoted to the purification of gas. Ancillary to these is a set of vessels for purifying the ammoniacal liquor; and also a set of Claus sulphur-kilns for the recovery of the sulphur from the waste gases of the liquor plant. The foul gas enters at the bottom of the first scrubber, passes upwards through it, and then enters the second. At the inlet of this scrubber, the gas mixes with a supply of gaseous ammonia from a still near by; and the mixture then passes through the other scrubbers. Cooled spent liquor from the still is pumped into the fifth scrubber, and thence through all the others, in the reverse order to the gas. The liquor leaves scrubber No. 1 fully saturated with ammonia and impurities, and is passed into the liquor purifying plant. This consists of a pair of vessels in which the liquor is heated to 195°. at which temperature about 70 per cent. of the ammonia and impurities are expelled from it, to be caught in other boxes, or (in the case of the impurities, sulphuretted hydrogen and carbonic acid) passed on to the Claus sulphur-recovery kilns. From the heaters, the partially purified liquor is pumped into the still already mentioned, where its ammonia is distilled off in the usual way. The ammonia and steam are passed through condensers, which arrest the water; and the gaseous ammonia goes into the second scrubber, as already described. The spent liquor from the still is pumped through coolers back to No. 5 scrubber, for use over again. The surplus due to condensation of steam is treated with lime for recovery of the fixed ammonia.

This is, in theory, all plain sailing. In practice, however, difficulties have been met with, which have not been so thoroughly removed as to inspire the Works' Managers with confidence in the process. It came to Belfast from Birmingham, with the credit of an experimental success. It was by no means for an experiment, but for a working plant, that the apparatus was admitted into the Ormeau Road station. The results have so far not been encouraging, as will appear from the fact that although it is at last treating three-quarters of a million cubic feet of gas daily, which is about one-half of the calculated capacity, it is not trusted to deliver this gas directly into the holders, but all is passed through the ordinary lime boxes for the sake of security. A long time has been spent in getting even so far. When the plant was first started, it soon came to a standstill on account of the serious loss of ammonia; and there was grave trouble with pumps and joints. Though it was got in order before The Gas Institute meeting, it required a fortnight to warm up to its work, during which it would have passed foul gas but for the intervention of the dry lime catch boxes. It will thus appear that, although there may be a great future for the Claus process—which we should gladly welcome—Professor C. W. Heaton's jubilations in our "Correspondence" columns for the 6th ult. were distinctly premature.

As to the Humphreys and Glasgow plant, there is little to be said beyond putting it upon record that Mr. Stelfox has found a corner for a ten-storied generator-house, in which 1½ million cubic feet of carburetted water gas per day is to be made, with its own accessory plant and a small check holder near it. This is to be ready by the winter, when it will be needed. The new retort-house is not far off; occupying a corner at the extreme end of the yard. It is to have an output of 2½ millions per day, from settings of eights in the style employed by Mr. Chester, at Nottingham, with regenerator firing and West's wire-rope power stoking. This house, with its arrangements and fittings, constitutes a study in the art of making the most out of scant room. An experiment is to be tried here with a view to prevent the nuisance of smoke and steam escaping into the outer air. A tall chimney is built at one end of the house; the shaft containing an annular air-flue surrounding the central gas or smoke flue. The retort-house and its roof do not show the usual vent-holes, but are tightly closed except from the side of the yard; while along the ridge of the roof there is a trunk pipe communicating with the air-flue in the chimney, and having openings at intervals over the settings. The idea is to leave as many of these open as may be required to carry off the smoke and steam from the settings in use; and it will be interesting to hear how the plan works.

It should be stated that nothing but lime is used for purification in Belfast; the material being cheap and good, and there being a ready sale for the spent lime for dressing the mossy land of this region. It is only too likely that the capacity of the purifiers will be strained to the utmost before the coming winter is over.

Meanwhile, the Corporation are bent upon keeping up the reputation of Belfast as a well-lit city, so far as the street lighting is concerned; and on the Thursday of The Gas Institute meeting, Mr. Stelfox made a special display of the effect of the high-power lamps in the main thoroughfares, which are ordinarily only employed in full during the winter season. As a matter of fact, Belfast would use all the gas it can get; and it will be a most suicidal policy on the part of the Commissioner to starve the town in this respect out of deference to a noisy few, who would be among the first to cry out if their own burners went dim. The resignation of the Commissioners in a body would show the citizens how serious is the issue now before the town.

Mr. J. E. Worth has been appointed an Assistant-Engineer to the London County Council, in place of Mr. W. Santo Crimp, whose resignation was notified in the JOURNAL some few weeks ago. Mr. Worth will take charge, under the direction of the Chief Engineer (Mr. A. R. Binnie, M.Inst.C.E.), of the sewerage and other engineering works north of the Thames, including the outfall at Barking Creek.

Society of Arts.—The Council of this Society have awarded silver medals to the following readers of papers at the ordinary meetings during the session of 1892-3: To Mr. W. Key, for his paper on "The Purification of the Air Supply to Public Buildings and Dwellings;" to Professor Frank Clowes, D.Sc., for his paper on "The Detection and Estimation of Small Proportions of Inflammable Gas or Vapour in the Air;" and to Mr. Gisbert Kapp, for his paper on "Some Economic Points in Connection with Electric Supply." The Albert Medal of the Society for the present year has been awarded to Sir John Bennet Lawes, and a like medal to Mr. John Henry Gilbert, "for their joint services to scientific agriculture, and notably for the researches which throughout a period of fifty years have been carried on by them at the experimental farm, Rothamsted." At the annual meeting of the Society last Wednesday, the report of the Council, dealing with the work of the past year, was presented; and the office-bearers for 1893-4 were elected. The great services rendered by the Chairman of the Council (Sir R. D. Webster, Q.C., M.P.) were recognized; and votes of thanks were accorded to the Secretary (Sir H. Trueman Wood) and the staff, for the able and conscientious way in which they discharged their duties. At a subsequent meeting of the Council, Sir R. E. Webster was re-elected Chairman, and Sir F. Bramwell, Bart., Deputy-Chairman, for the ensuing year. The *conversazione* of the Society took place at the Imperial Institute, on Friday last, when, by the courtesy of the Council of the Institute, the whole of the buildings were placed at the disposal of the visitors.

NOTES.

The Theory of Light.

A controversy has been going on in several scientific journals on the subject of the degrees of validity and comprehensiveness attachable, in the present state of knowledge, to the Newtonian theory of gravitation, the undulatory theory of light, and allied matters. Dr. Oliver Lodge has recently summed up the discussion in a letter to the *Engineer*, in which certain noteworthy expressions occur. Dr. Lodge admits that the theory of light is not complete, and that the theory of the ether is hardly begun. The same remark applies to the theory of matter, and also to that of gravitation. But we do not therefore call matter a hypothesis, or doubt the fact of its gravitative attraction. Whatever may be hereafter discovered about the cause of gravitation, the Newtonian laws of its action cannot be upset. They are true, albeit, of course, they are not the whole truth. So with the wave theory of light. So far as it goes, it is true, and is not likely to be upset by any discoveries of the future. The ultimate mechanism of light is, indeed, still unknown. The complete theory of light has yet to be made; but nevertheless it certainly consists of transverse waves in a medium, and the frequency and length of these waves are known with as great accuracy as the frequency of a tuning-fork and the length of a metre. These, Dr. Lodge observes, are not random statements; and the complex facts of optics are explicable on the wave theory just as the facts of astronomy are explicable on the gravitation theory. To call either the complete theory, or to pretend that any assertion yet made by man is the whole truth about anything, however apparently simple—this, Dr. Lodge emphatically declares, would be a procedure less than sane.

A Simple Optical Photometer.

A simple optical photometer, serving also to measure the degree of visual acuity, has been devised by Dr. Simonoff. A book of twenty-four pages is arranged; the first being of a clear grey tint, the second of double the intensity, and so on to the last, the colour of which is nearly black—being twenty-four times the intensity of the first. On every page are printed a few phrases in black letters of different sizes. The amount of illumination available in a badly-lit apartment may be estimated by turning over the pages of this little book, held at a distance of about a foot from the eyes, until one can no longer read the line of letters of a selected size. With good illumination, the characters on the twentieth, or even the twenty-fourth page may be read; but with poorer light legibility ceases at the tenth, or twelfth, or fifteenth page. The appliance is meant for indoor use exclusively, and must, of course, be employed with intelligent reference to the power of the eyes of persons making the test. But it is said to give fairly reliable comparative indications of the degree of lighting in a building; and it is likely to be useful in ascertaining the sufficiency of the lighting of class-rooms and public buildings intended to be used for educational purposes.

Plant Cultivation in Foggy Air.

Professor F. W. Oliver's second report on the effects of urban fog upon cultivated plants has been presented to the Royal Horticultural Society, and is printed in full in the Society's Journal. In this report the effects of fogs upon vegetation are considered under the two aspects of the poisonous results produced by the contact of fog itself upon the leaves of plants, and the reduction of light due to the presence of fog in the air. If the former influence could be eliminated, Professor Oliver does not think the reduction of light alone would be a very serious cause of complaint. It is when aërial contamination is added that the mischief is done. As to the possible neutralization or the absorption of fog after it has entered a plant house, Professor Oliver is not hopeful; having tried several suggested remedial measures without definite results. He has not found that carbonate of ammonia, for instance, exerts any noticeably beneficial action as a neutralizer of the acid vapour of fog, which he regards as a complex product, presenting the difficulty that anything which might neutralize one constituent would probably leave the others free to do their damage. The scope of the report does not extend to a discussion of the large question of the abolition of fog; and Professor Oliver says that even the most sanguine of the present generation can hardly hope to enjoy any abatement of the fog nuisance. The best palleative for stove houses is simply to cover them with sheets of canvas. Professor Oliver also speaks favourably of a device of Mr. Toope, of Stepney, which provides for the filtration of air through charcoal; and he gives it as his opinion that much of the sulphurous acid may be removed from town air by this means, so that by the use of Mr. Toope's plan dwellers in the foggiest and smokiest towns may hope to indulge in plant cultivation under glass.

The Specific Heat of Carbon.

In a communication to the *Comptes Rendus*, M. Le Chatelier draws attention to the fact that the specific heat of carbon cannot be made to agree with the law of Dulong and Petit. Monckman has already mentioned that Weber's experiments on the variation of the specific heat of carbon do not point to a law tending asymptotically to a fixed value, as is commonly asserted. On the contrary, these experiments indicate a continuous increase of the specific heat of carbon above 250° C. At this point the law of variation undergoes a sudden change; and the same discontinuity is observable at this temperature in regard to all the other properties of carbon—electrical conductivity, expansion, and thermo-electric capacity. Recent experiments by MM. Uchène and Biju-Duval, who are Engineers on the staff of the Paris Gas Company, support Monckman's interpretation. Numerous experiments of these investigators show that the specific heat of graphite, or retort carbon, increases with the temperature from 250° to 1000° C., and that the rate of increase is even higher than would appear to result from Weber's experiments. The atomic specific heat of carbon is therefore expressed by the following formulæ: From 0° to 250° it is $c = 1{\cdot}92 + 0{\cdot}0077\,t$; from 250° to 1000°, it is $c = 3{\cdot}54 + 0{\cdot}0246\,t$.

COMMUNICATED ARTICLE.

COAL GAS: ITS MANUFACTURE, DISTRIBUTION, AND CONSUMPTION.

A Series of Articles for Gas Students.

(*Continued from Vol.* LXI., *p.* 1211.)

DISTRIBUTION.

Main and Service Pipes.

The term "main-pipes" may be held to mean those leading pipes which convey the gas into the district of consumption along the various streets and thoroughfares, and from which the supplies to individual consumers are taken. "Service-pipes" are those through which gas flows from the "mains" to consumers' meters and public lamps, sewer ventilators, &c.; and they may be of large or small diameter, according to the requirements of the consumption.

In this country, main-pipes from 3 inches in diameter and upwards are usually of cast iron. It sometimes happens, however, owing to the shallowness of the roads (as when bridges, subways, &c., have to be crossed) or to underground vibrations, and for other reasons, that the rigid cast-iron circular pipe of large diameter cannot be accommodated, or only at the risk of fracture, with its attendant dangers of leakage and explosion. In such cases, the mains are now often constructed of riveted wrought-iron or steel plates, not unfrequently being of oval or oblong section, and thus requiring but little depth while giving a large sectional area. Pipes of smaller diameter than 3 inches are seldom used as mains; and in any case they are preferably of wrought iron—being fitted, wherever desirable, with the ordinary wrought-iron T connections, supplemented by long-screws where each service-pipe is taken off.

There are in general use in England only two methods of jointing mains—viz., the "open" lead joint, and the "turned and bored" joint. For both methods, the pipe is cast with a "socket" at one end for the reception of the "spigot" or plain end of the next length of pipe. Pipes designed for the open lead joint may with advantage have a small half-round bead cast around the spigot end. The socket is made large enough to receive the spigot end, and leave an annular space all round the latter for the reception of molten lead, which, when all is ready, is run in from a ladle, and which varies in thickness from $\frac{1}{4}$ to $\frac{1}{2}$ inch, according to the size of the main; the depth of the lead joint in the socket also varying from (say) 2 to 4 or 5 inches. When laying the pipes, the inner part of the annular space is filled with coils of tarred yarn or twined gasket, driven in with a caulking-tool. The outside face of the joint is then closed up with a roll of plastic clay, which is pressed up against the socket face; a lip being formed on the upper side of the pipe. Through the lip is poured molten lead, which fills up the space enclosed by the clay and the tarred yarn between the two pipes. The clay is then removed, and the joint "set up" with flat-ended chisel-shaped tools, or "sets." A lead joint, when well set up, should present a smooth unbroken surface all around the pipe. The stream of molten lead must be continuous until the space is filled, otherwise a sound joint cannot be ensured. If the lead be poured on to wet or damp pipes, it is apt to fly badly, to the danger of the workmen.

Pipes designed for use with turned and bored joints have the inner face of the socket and the outer face of the spigot turned in a lathe perfectly true, and with a *very slight* taper. (Some taper, of course, is necessary; but if too sharp a sound joint cannot be relied upon.) It is not unusual to cast the sockets of these pipes with a recess for lead, for use in case the turned joint should prove defective. This is a plan which the writer would always recommend. The lead joints is also used when turning sharp sweeps or curves. Preparatory to placing the pipe in position, both the spigot and the socket are carefully cleaned (and they may be rubbed over with oil), then painted over with a mixture of red and white lead; every precaution being taken that no dirt or soil gets into the joint during the lowering of the pipe. The spigot is then inserted into the socket, and driven home with a swing-block.

When laying a new main, either as a branch from, or a relay of, an existing or "live" main, the flow of gas in the latter must be cut off at the point where the alteration is being made. Where, as is usually the case, especially with large undertakings, the various mains are all tied together, it is necessary

to stop the flow from both ends of the section interfered with. Except in the very rare instances where this can be done by means of valves, it is effected by an improvised temporary valve, as follows: At a point a yard or two away from where the main is to be cut, a hole is made in the pipe and tapped. Through the hole is inserted (if but a small main) a bullock's bladder, previously softened, and provided with a tap. If the main is of large diameter, an india-rubber gas-bag, nearly spherical in shape when fully blown out, and provided with a length of tube and an automatic valve, is used instead. When sufficient of the bladder, or the bag, has been inserted, the hole around the tube is made up with clay, and the bag inside fully inflated, and the tap closed. By this means the main has been most effectually plugged—the inflated bladder pressing all around the inner wall of the pipe; and if the bag or bladder be air-tight, little or no gas will pass it. With large mains, it is safest to use two such bags. The same plan is adopted at the other end of the section which is being relaid. When the section is completed, the bags are emptied of air, and withdrawn through the small holes. Plugs are then screwed into the latter, and jointed with white lead; while the bags are again inserted farther on.

When a section has been completed and is ready for gas, the bladders at one end only are first withdrawn; and the gas thus admitted forces the air contained in the pipes through a stand-pipe or hole provided near to the bags at the other end of the section. When the foreman is satisfied by the smell at this stand-pipe (not by fire) that all the air has been expelled, and that the new main is fully charged with gas, he can withdraw the latter bags, but not until then. To test whether or not all the joints in the new section are sound, it is better to use a brush and soap and water (thick) around them, than to employ a light. The latter method has its risks, and moreover is not reliable; while by the former, if the water be thick enough (soft soap is the best for the purpose), the smallest escape will be readily detected.

Mains are laid with a fall which may vary according to the inclination of the road-level; but it should not be less than from $\frac{1}{8}$ to $\frac{1}{4}$ inch to every 9-feet length. At the necessary intervals, where the main is at the lowest and commences to rise, cast-iron wells, or "syphons," are provided, into which drain all the aqueous matter that has condensed in the main. These syphons are made in two forms. One is a cast-iron cylinder, on either side of which are cast sockets, right and left, for the reception of the main which it intercepts, and which drains into it. The other form is also usually cylindrical, and is placed either beneath or at the side of the main, but on a lower level. A small wrought-iron pipe connects the main to the syphon, and through it the liquor drains. Both forms of syphon are provided with an upright wrought-iron pipe, or "stand-pipe," which, passing down to within about an inch of the bottom of the syphon, is carried upwards to some 3 inches of the road-level, and surmounted by a cap of special pattern; the whole being suitably encased, and covered in at the top by a proper syphon cover. The accumulated condensed liquor is periodically pumped from these syphons; otherwise the main would become "waterlogged."

The branch pipes for the several streets, bends, crosses, &c., are all provided for by special cast-iron connections, such as T's, X's, Y's; sweeps, double collars, &c.

The average depth from the top of the pipes to the road-level should, wherever possible, be not less than 2 feet; thus lessening the liability to fracture from heavy traffic, and also removing them from the direct influence of climatic changes. Where pipes have to be carried across exposed positions, as when they are slewed across the outside of bridges, &c., they should be covered with felt or other non-conducting material. The ground on which they are laid must, if necessary, be punned solid, and sleepers provided at intervals when a satisfactory bottom cannot otherwise be secured. When filling in, every care should be taken to secure even solid ramming of the soil, and thus prevent unequal settlement of the pairing.

It is sometimes deemed necessary to test an existing main for soundness. This may be done by dividing it into sections, cutting off the supply into each in rotation, and connecting the cut-off section with the "live" mains through a test meter. If there be any defects in the section under test, the gas from the live main will pass by the connecting-pipes, through the meter, and into the section, and thence escape; the amount of leakage being registered by the meter. The process is repeated, section by section, throughout the length of the main, to be tested. A more rough-and-ready method, and perhaps not much less satisfactory, is simply to make a search-hole, by means of a steel search-bar—preferably of hexagonal or octagonal section to facilitate its withdrawal—in close proximity to each socket joint along the length, and to the full depth of the bottom of the main. If the ground is fairly solid, and there are no confined spaces near, the holes thus made may be safely tested with a light; and if gas be present, even in small quantity, it will burn with a more or less blue light. Where there has been settlement in the ground, hollowness, or other cause of confined spaces, a light must not be used; and the holes may be tested either with a Parkinson leak-detector, or by Nature's own test—the nasal organ. (The writer has invariably found the latter test to be superior to any other in aiding a search for the *locale* of a gas escape.) It is generally a fairly easy matter to judge of the position of the most serious defect. When this has been decided upon, the ground is opened down to the main; the hole being carried to below the bottom of the pipe, so as to cut off any earth communication for travelling currents of escaped gas. If the exact place has not been dropped upon, a few horizontal search-holes, following the direction of the main, and on either side of the excavation, will at once decide the direction in which further excavation must be made. When much gas is escaping, great care has to be exercised in the use of the picks, in order that sparks struck from concrete do not ignite the gas, and give rise to much trouble, not to speak of danger, to the workmen. If the defect, when found, should prove to be a drawn socket, it is rectified by setting up the joint again—adding more lead, if necessary. If it should be a broken pipe, the fracture is usually temporarily bandaged up with stout calico well plastered with white lead, and the pipe afterwards replaced by a fresh one; the joint between the new and the old pipe being made by means of a double socket. If subsidence has caused the fracture, the main must be fully supported by brick piers, sleepers, or other means.

Service-Pipes.

For sizes up to $2\frac{1}{2}$ inches in diameter (inclusive), service-pipes are generally of wrought iron. Lead, however, is sometimes used; being strongly recommended by some authorities. When lead pipes are employed, they must be supported throughout their length, to prevent sagging and the consequent accumulation of water. All service-pipes, of whatever material, should, if possible, be laid with a fall to the main. If this be impracticable, the fall should be the other way; and at the lowest point there should be provided a bottle-syphon, into which the pipe may drain. The joints of wrought-iron connections are made sound by painting with white lead prior to screwing up, and, where back-nuts are used, by a small grummet of hemp and white lead placed between the socket and the back-nuts. Connectors, or "long-screws," should be inserted in each service-pipe, both near to the house and near to the main, so as to facilitate cutting off the pipe outside when required. It is a dangerous practice to leave service-pipes "alive" when meters are disconnected and the house is empty. Moreover, it is perhaps not the best economy, in the long run, to supply several meters in one building from a single service-pipe by means of T connections, owing to dangers that may arise, either through mistake or through misadventure, to one or more of the T'd-off supplies while another is being attended to by the workmen. Much trouble is sometimes experienced through the deposition of naphthalene, or owing to the collection of water, or the choking up of the service-pipes through corrosion. A safe, as well as effectual, method of clearing the pipes is by the aid of an air force-pump. When this appliance is not strong enough to remove the obstruction, it is time the pipe was relaid.

Service-pipes may be rendered much more durable by being well painted with two or more coats of good oxide paint. When they have to be laid in ground made up of chemical, foundry, or similar refuse, they should be encased in V troughing, filled up with hot pitch. This will protect them from being eaten into and destroyed by the acids taken up from the soil, and contained in solution by the surface water. The connections into the main pipes are usually made by first drilling the main at the point whence the supply is to be taken, then tapping or screwing the hole thus drilled (which is preferably on the top of the main, not at the side). A bend is afterwards screwed into the main, and on the bend a long-screw; and the pipe is then continued direct into the house—a main tap being fixed on it as near the front wall of the house as possible. When the service-pipe is of sufficiently large diameter to warrant the use of cast iron, the connection may either be made by cutting out a main-pipe and inserting a cast-iron T of the requisite size, or by fixing on the main a "saddle-piece" of the required diameter, the flange being cast with a curve to suit the main. The saddle-piece is fitted on with four or more set-pins; the joint being made with millboard, which, previously thoroughly soaked in water, has been well painted on both sides with red lead. When the service-pipe is of large diameter in proportion to the main—as (say) a 2-inch out of a 3-inch, or a 3-inch out of a 6-inch—the connection with the main may be cast iron, as just described; all the remaining part of the service being of wrought iron.

The Flow of Gas through Pipes.

By way of supplement to the foregoing remarks on mains and service-pipes, it may be of interest to the student to refer briefly to the subject of the flow of gas through pipes. The formula given below is from Dr. Pole's essay on "The Motion of Fluids in Pipes" (see "King's Treatise on Coal Gas"); and a few examples are appended, to show the application of the formula with relation to the capabilities of mains of varying diameter.

Let h = pressure of gas in inches of water,
d = diameter of pipe in inches.
s = specific gravity of gas (atmospheric air being 1.)
l = length of pipe in yards.
Q = quantity of gas in cubic feet discharged per hour by the main.

Then $Q = 1350\ d^2 \sqrt{\frac{h\,d}{s\,l}}$

Expressed in words, the rule is: Muliply the pressure of the gas in inches of water (h) by the diameter of the pipe, also in

inches (d). Divide the product (hd) by the specific gravity of the gas multiplied by the length of the pipe in yards (sl). Extract the square root of the quotient $\left(\sqrt{\frac{hd}{sl}}\right)$ and multiply this root by the square of the diameter in inches (d^2), and then by the constant 1350. The result will be the number of cubic feet discharged per hour (Q).

Example 1.—What will be the discharge of gas from a 10-inch main 1000 yards long; the pressure of gas being equal to a column of water 10-10ths of an inch in height, and the specific gravity of the gas being 0·400 (air = 1)?

(*a*) $\sqrt{\frac{hd}{sl}} = \sqrt{\frac{1 \times 10}{0{\cdot}4 \times 1000}} = \sqrt{0{\cdot}025} = 0{\cdot}1581.$

(*b*) $d^2 = 10 \times 10 = 100.$ $100 \times 0{\cdot}1581 = 15{\cdot}81.$

∴ (*c*) Q = 1350 × 15·81 = 21,343 cubic feet per hour.—*Answer.*

Example 2.—Coal gas, of the same specific gravity as the above, is forced through a 16-inch main one mile long at a pressure of 15-10ths of an inch. What will be the discharge per hour in cubic feet?

Here $\sqrt{\frac{hd}{sl}} = \sqrt{\frac{1{\cdot}5 \times 16}{0{\cdot}4 \times 1760}} = \sqrt{0{\cdot}0341} = 0{\cdot}1846.$

And $d^2 = 256.$ $256 \times 0{\cdot}1846 = 47{\cdot}257.$

∴ Q = 1350 × 47·257 = 63,796 cubic feet.—*Answer.*

Example 3.—Required the discharging capabilities of an 18-inch main at a point 2000 yards away from the works; the same being charged with gas of ·4 sp. gr., at a pressure of 15-10ths of an inch.

This case will come out in figures thus:

$$Q = 1350 \times 324 \times \sqrt{\frac{1{\cdot}5 \times 18}{0{\cdot}4 \times 2000}} = 80{,}002 \text{ c. ft. an hour.—}Ans.$$

The Opposition to the Accrington Gas and Water Bill.—Last Friday afternoon, an arrangement was made with the Commons Committee (of which Mr. de Tatton Egerton is Chairman) who have the Accrington Gas and Water Bill under consideration, to fix the further hearing of the proceedings for Wednesday, the 12th inst. It was stated that the negotiations as to purchase had failed, and that the investigation of the charges made by the Corporation against the Company would be proceeded with. It was agreed that the books of the Company should be open to the inspection of the Corporation's accountants, so far as might be necessary for sustaining certain allegations which have been formulated, at the office of Mr. Alfred Lass, F.C.A.

Difference of Potential between Water and Gas Pipes.—In a recent number of the *Génie Civil*, a correspondent shows that there is a difference of potential between the water and gas pipes in all houses, and that if one terminal of a telephone is joined (say) to the water-pipe, on lightly touching the gas-pipe with the other a crackling sound is heard in the telephone—indicating the passage of a current. By replacing the telephone by a galvanometer, it is found that the negative pole is formed by the gas-pipe, and that the galvanometer deflection is permanent and constant in amount during several months, though there is a slight diurnal variation. The author attributes these currents to a slow chemical change in the pipes.

Compressed Oil Gas for Lighthouse Illumination.—The principal feature of the East Usk lighthouse, which has lately been erected for guiding vessels entering and leaving the mouth of the Usk, is its automatic illumination by means of petroleum gas. The lighthouse, which is entirely of iron, rises in tower shape, supported on iron piles driven in the ground, to a height of about 50 feet. The petroleum gas which constitutes the illuminant is stored in two large tanks placed on end on the ground. The gas is conveyed to the tanks every month or six weeks from London, and is compressed to about 80 lbs. per square inch. The gas proceeds by tubes to the lantern; and its supply and consumption are governed by clockwork. The machinery so regulates the lantern that the light is only turned on at sunset, and is turned down (though not quite extinguished) at sunrise. The work was carried out by the Trinity Board, under the direction of their Chief Engineer (Mr. T. Matthews).

Presentation to Mrs. Hislop.—On Monday afternoon last week, a presentation of a somewhat unique character took place at Craigielee House, the residence of Mr. George R. Hislop, Gas Engineer to the Paisley Corporation. During his professional career, Mr. Hislop has had, either as pupils or in his employment, a large number of gentlemen who now occupy responsible and important positions in all parts of the world. Holding their tutor in the highest respect, they recently, quite spontaneously, resolved to give expression to this feeling in a tangible manner. Mr. James M'Gilchrist, Gas Engineer to the Dumbarton Corporation, was requested, on behalf of the subscribers, to make the presentation. Accordingly, on the above-named day, he proceeded to Craigielee House, and, without any of the ordinary formalities, presented to Mrs. Hislop a chaste and valuable gold diamond bracelet and diamond ring. Mr. Hislop expressed his extreme gratification at this token of remembrance from his old pupils and employees, and desired Mr. M'Gilchrist to convey his and his wife and family's thanks for the presentation, and his ardent desire that they should all still further make their way in the world.

TECHNICAL RECORD.

WESTERN (U.S.A.) GAS ASSOCIATION.

The Sixteenth Annual Meeting of this Association was held at Chicago on the 17th, 18th, and 19th of May, under the presidency of Mr. B. E. Chollar, of St. Louis. There was a large attendance of members.

The President, after some formal business, opened the proceedings with a short Inaugural Address. He alluded to the fact that the present Association was established at a meeting held at St. Louis sixteen years ago, and attended by only a small body of 16 members. He then compared the prevailing circumstances of the gas industry at that time to those at present existing; attributing a great deal of the energy and ability now applied to the production of cheap gas to the discovery and subsequent competition of petroleum. In order to maintain profits at the reduced prices thereby necessitated, it was found desirable to convert what had hitherto been a business vocation into a scientific industry; but the benefits of organization were greater in the manufacturing than in the distributing department, and of small and questionable value as regarded the mere business, which the owners had managed in their own way before the Association was thought of, and would continue to do. He therefore strongly advised a close adherence to the true and logical purpose of the Association. Not that the money-getting department was not of equal importance, but it depended more on personal tact and intuition than on the advice of others. One was more likely to take counsel with others, for instance, on the construction of a condenser, than on keeping a cash account. It must also be remembered that the proceedings were published; and therefore it was wise to keep to the practical side only, and discuss mere business matters during the recesses. After a glance at the importance of encouraging technical schools, and any other means that would promote the highest possible degree of scientific knowledge in their profession, Mr. Chollar alluded specially to the development of a better lighting efficiency from burners, and to the destructive action of electric currents on mains and services, as prominent questions at the present time.

Special Committees were then appointed; and the report of the Board of Directors, which included a recommendation to the effect that they saw no reason for making any change in the rules governing the reporting of the proceedings (in reply to a requisition from some of the members urging some alterations), was adopted by the meeting without discussion. A Committee appointed to consider the revision of the constitution and bye-laws presented a full report. Among the special features of the proposed charter, it is noticeable that the Directors—*i.e.*, the Committee—meet the day before the general meeting, and decide on the propriety of the papers, drawings, &c., submitted; that the President, two Vice-Presidents, and the Secretary form an Executive Committee, which meets three months before the general meeting, and selects subjects and assigns authors for the papers; and that a member proved to have violated any of the laws, or to have been guilty of conduct "unbecoming a gentleman," may be expelled, after a hearing, by a vote of at least three-fourths of those present. After a lengthy discussion, and one or two verbal alterations, the suggestions were accepted by the meeting; but, according to a clause in the new constitution, they must be brought forward for further consideration at the next meeting, before they can be finally adopted.

After some other formal business, the reading of papers was proceeded with. "Residuals: Ideas concerning Them Suggested by the Outlook," was the title of a communication read by Mr. J. Ferrier, of Columbus (Ga.) He ascribed the present depressed condition of the tar and ammonia market as being largely due to the absence of concerted effort amongst gas companies. He knew of two undertakings, not a hundred miles apart, that were selling their tar to the same firm, but one received just two-and-a-half times as much as the other. He was aware of similar instances in regard to the price of coke. In considering the best way of remedying this state of things, he recommended a careful study of the methods by which the use of petroleum products had been promoted. Perhaps it would be too much to take the whole thing in hand at once; but they could all commence the manufacture of sulphate of ammonia, and small companies might combine for this purpose, or sell to larger ones. At present, few worked up their own ammoniacal liquor. A centrally situated company might undertake the superintendence of sales of residuals. From making sulphate, they could in time proceed to deal with tar products. In united effort and confederation would be found the key of the residuals question.

Mr. G. T. Thompson, of St. Louis, contributed a paper on "Wrinkles;" comprising illustrated descriptions of several little devices he had adopted from time to time. The first mentioned was an adjustable support for retort mouthpieces, made of wrought-iron pipe. The next was a sight-feed for oil-gas retorts, similar in design to the sight-feed lubricators sold in this country; the nozzle being enclosed in a glass cylinder. An adjustable safety overflow for hydraulic mains, which was made up of wrought-iron pipe and fittings, provided for taking the tar from the bottom of the main, and equalizing the pressure

between the hydraulic main and the outlet. The principal feature of this was a short piece of pipe, screwed into one end close on the bottom, to which an elbow or T was attached; a short length of rising pipe screwed into the T; and a ¾-inch connection from the top part of the hydraulic. The adjustment is obtained by turning the upright up or down; the T acting as a hinge. Another "wrinkle" was the quieting of a groaning station meter by pumping in, below the water-line, a hot-water solution of soft soap. For joints requiring to be occasionally moved, the use of ordinary putty was recommended instead of lead, after driving in yarn as customary. In place of the usual spring for keeping up the point of the pencil to the paper in registering apparatus, a weighted lever is employed, as affording a uniform and easily adjustable arrangement. But perhaps the chief novelty in the paper was a substitute for a photometer screen, comprising simply a ¾-inch tube and a piece of white crayon. Slots about 2 inches long are made in the tube near one end; and they serve to receive the light on each side. The crayon is evenly cut to a chisel edge, and fixed in the axis of the tube with the edge in a vertical position. The respective lights show on each bevelled side; and, when the right position is reached, the edge disappears, and the surface presents a flat. This is preferred to the ordinary screen. In his concluding remarks, the author suggested the formation of a "wrinkle" department as a permanent feature at the meetings. The reading of the paper was followed by an animated conversational discussion.

Mr. H. D. Walbridge, of Grand Rapids (Mich.), next read a paper in which he indicated, under the title of "Utopia," the principal points to be aimed at in the management of a gas company. Given a moderate capital and careful economy in the manufacturing department, leading to a good quality gas at a low price, the "Utopia" should have a clerical staff combining a pleasing address with intelligence, care, and thorough knowledge of every detail, so as to ensure prompt and accurate information to all customers and inquirers. The motto for the office should be "We strive to please;" and for the stoves and fittings department, "No trouble to show goods." The latter department should be under the superintendence of a competent manager, who would ensure prompt attention to all orders and complaints. Meters should be tested, and the fullest attention given even to the most trivial complaint, the matter being fully explained to the customer; and escapes in customers' fittings should, of course, be stopped without charge. Good burners should be supplied gratis; and a man should always be in attendance throughout the night, so that a complaint coming in late in the day need not be put off till next morning. But having all this, the company should not wait for customers to come in, but should run an advertising department and conduct an educational campaign, employing a competent man to look after, and to drum up, trade. They should also have rules respecting internal piping of houses, and inspectors to see that the rules were enforced. And in slack times, the inspectors could call upon consumers and either personally remedy, or report as to, defects in burners, &c. The show-rooms would comprise the best kinds of gas burners or appliances, with test-meters, &c., for indicating the consumption of gas.

The next paper taken was entitled "Gas Analysis," by Mr. O. O. Thwing, of St. Louis, and consisted of a description, illustrated by practical experiments, of the method of using the "Cooper tube" for the quantitative determination of sulphuretted hydrogen, carbonic acid, oxygen, illuminants, and carbonic oxide, by means of the usual absorbents, in coal gas.

Mr. J. R. Smedberg, of Chicago, followed with a paper on "Wood Gas during the War." It was in the year 1854 that a wood-gas apparatus was adopted at Philadelphia; and it was operated for some few years. Cresson's cellular retort was employed, in which the gas produced in a ⏢-shaped chamber traversed longitudinal passages under the bottom before reaching the stand-pipe. It was found that one cord of ordinary firewood yielded twice as much gas, and that of equal quality, as was afforded by a ton of the best Pittsburg coal. One cord of pine was equal to 800 lbs, and of oak or maple to 900 lbs. of sperm. If carefully dried and split, its value was increased 50 per cent.; and the quality of wood gas was about 28 candles. In 1857, 30 million cubic feet of wood gas were produced; and great advantages were claimed for the system. It was said to be cheaper than coal; but it failed to obtain a permanent foothold in any of the middle or northern states. It was, however, used in the South. At Savannah, they had large ⏢-iron retorts; and they used 1000 lbs. of wood a day per retort, working 1½-hour charges, and obtaining 10 cubic feet of 18 to 20 candle gas per pound. A great deal of difficulty was experienced in the matter of cutting and transporting the wood; and the light wood of the South was found to be very different from the pine, oak, and maple of the North. In many parts of the South, the trees had been "girdled," and the dead trunks allowed to stand for many years. Sometimes they had been tapped for resin. A cord of light wood weighed 3550 lbs.; and the yield of gas would vary from 8 to 15 cubic feet per pound, according to quality. "Tapped" wood was, of course, poor; but the girdled wood, by losing moisture and outer dry fibre under the long continued action of the hot sun, gradually became converted into a mass of rich hydrocarbons —the whole of the resinous matter being retained. It required, however, to be carefully kept from rain, and would even deteriorate if split and stored under cover. Like coal, it could not be advantageously carbonized in large blocks; and the evolution of gas was so rapid, that care was required in working, to avoid lowering the heats. For the same reason, it was necessary that the wood should be well dried. After prolonged careful experiment, it was found that charges of 62½ lbs. per retort, worked for 1¼ hours, gave the best results; and these conditions were observed for upwards of three years. If the wood was broken too small, the condensable matters were increased at the expense of the permanent gas. Sticks of 16 square inches or so in section were found to give the best results; and the chippings and smaller pieces were always thrown to the back. For every cord of wood carbonized, another was required for firing; and judgment was exercised in setting aside the wood either for gas making, or for fuel, according to its quality. Although endeavours were made to use the common pine for the fires, it was found that the higher-priced light wood was really the cheaper in the end. Notwithstanding the time lost in drawing and charging, about two-thirds of the gas came off in the first half hour. For some time they worked with low heats; and were annoyed with frequent stoppages in the ascension-pipes, flooding of seals and syphons, and a heavy item of unaccounted-for gas. But after practical experience, leading to improved firing and charging, the process actually proved superior to coal gas in these respects. In spite of every care being taken, a large proportion of carbonic acid was produced; and the illuminating power ranged from 22 to 16 candles, according to the condition of the lime-boxes. Turning on a fresh purifier caused the make to fall back 14 or 16 per cent. The light wood gave less trouble from this source than other kinds; and when using it, his average consumption of lime was one bushel to 12,000 cubic feet of gas. The holder gave rather more pressure with wood than with coal gas; and the leakage rose from 7 to 14 per cent. In "King's Treatise on Coal Gas," there was a reference to the property of resin gas—especially when used as an enricher—of depositing a viscid matter in pipes and fittings; but he was not troubled by anything of this sort. There was absolutely no deposit; and the burners used were the ordinary coal-gas tips, enlarged at the orifices. At Virginia (Nevada), gas was made from pitch pine, Hartley mineral from Australia being employed as an enricher; and a fair quality gas was obtained, although no lime was used. The gas was heavier than air, and supplied a district 300 to 400 feet below the level of the works, yielding actually a higher pressure at the lower level. The author thought that the wood gas suggested by Lebon was produced at too low a heat to be of much value; and that Pettenkofer, who, in 1842, proposed to pass the product from the retorts through red-hot pipes, was really the father of the wood-gas process. After this came the use of large retorts worked at high heat, and of the drying-room for preparing the wood for the retort. High heats, light charges, and plenty of red-hot surface were found the best. Pettenkofer was the originator of the idea of passing the gas from one charge through the incandescent charcoal remaining from a preceding one, so as to reduce the carbonic acid to carbonic oxide, a modification of which was employed by Wilkinson at New York, with through retorts. By this means, a cord of wood weighing 3300 lbs. would yield more than 50,000 cubic feet of non-luminous gas; and the carbonic acid was reduced from 25 to 30 per cent, to about 10. The author did not think wood gas could compete with petroleum; but there might be places where wood was cheap and petroleum dear.

In reply to a question, Mr. Smedberg said that the wood gas at Virginia contained 35 to 40 per cent. of carbonic acid; but sufficient Australian shale was used to bring it up to about 16-candle power. By extracting the carbonic acid, it could be raised to about 50 candles; and the specific gravity was about equal to that of air.

The meeting concluded with the usual votes of thanks.

ELECTROLYSIS OF A SERVICE-PIPE.

In view of the inquiry just concluded by the Joint Committee of the Lords and Commons on the subject of electrolytic action on gas and water pipes, to which reference is made in another part of the JOURNAL to-day, the accompanying illustration, which is copied from *Progressive Age*, possesses special interest. It shows a portion of what was once a 2-inch wrought-iron coated service-pipe; and it was taken from under a covering of 3 feet of earth in front of the power-house of the trolly railway at Battle Creek (Mich.). The system in use is known as the "Short Electric"—using the rails for the return current;

and it has been in operation for about 18 months. The "trolly," says our contemporary, has brought many discomforts to the communities in which it has been introduced; and it is a constant source of anxiety to gas and water companies, whenever it is employed. It is the return current which is, in the main, responsible for the electrolytic action; and it appears to be the same whether the pipes are galvanized, tar coated, or of the so-called "rustless" make.

REGISTER OF PATENTS.

Automatically Varying the Load and Pressure of Gas-Governors.—Cowan, W., of Edinburgh. No. 9829; May 24, 1892. No. 18,855; Oct. 21, 1892. No. 20,721; Nov. 16, 1892.

The above-named three patents, together with one dated Dec. 30, 1891 (No. 22,737), form a series of inventions, all having the same general object in view—the provision of appliances for automatically changing the pressure of gas throughout a district by means of governors actuated at the works. The patent of 1891 was described and illustrated in our issue for Jan. 3 last, p. 19; while Mr. Cowan himself communicated an account of certain of the subsequent stages of the invention in the JOURNAL for May 16 last (p. 886). The last of the series is dealt with in a communication by Mr. Cowan already in type, and for which we hope to find space in an early issue.

Regenerative Gas Heating and Cooking Apparatus.—Higginson, H., of Liverpool. No. 10,996; June 11, 1892.

Under this invention, heating and cooking apparatus is constructed with a case or chamber, having in the interior series of gas-jets placed close together, and supplied with air to support combustion through ways heated by the gas-jets, and delivering the air beneath the jets. In the heating ranges, the walls are hollow, so as to serve as ways for heating air to support combustion, and for delivery into the space to be heated. In cooking apparatus, openings are provided to receive pans or utensils directly above the gas-jets; and these are in connection with a chamber through which the products of combustion pass. This oven has openings near the bottom; and the door is made hollow, so as to serve as a flue for the products of combustion. The door is provided with an arrangement to partly cut off the supply of gas when open.

Starting Gear for Gas-Engines.—Clerk, D., of Sutton Coldfield. No. 11,936; June 27, 1892.

This invention relates to improvements in self-starters for gas-engines of the type described in patent No. 18,788 of 1891, in which the explosion of a combustible mixture is caused to compress an explosive or combustible mixture; and this compressed mixture is ignited, so as to give a power of compression explosion, and so start the engine.

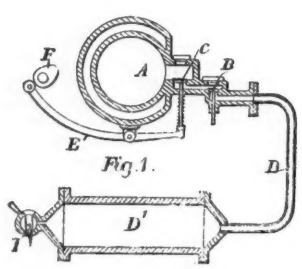


Fig. 1.

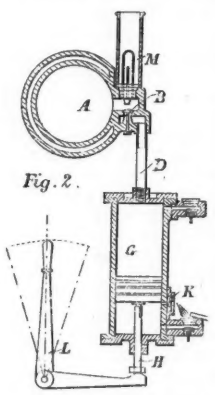


Fig. 2.

In one modification of the self-starter, an explosive mixture is ormed in, or passed into, a chamber or space outside the cylinder, separated from the cylinder by a check-valve; and the mixture is also formed in, or introduced into, the cylinder. The chamber is formed by a long pipe; and part of the present invention consists in adapting the air-supply pipe of the engine for this purpose, as shown at fig. 1. To enable this to be done, a check-valve B is applied above or below the gas and air inlet-valve C; and this air inlet-valve is held open by a pin acting on the lever E, while the engine piston is set a little forward on its working stroke. The air-pipe D, with its silencing chamber D^1, and the combustion space A are then charged with combustible mixture by a pump or other means; and the mixture is ignited, at a point I distant from the check-valve, by a flame-igniter or other means—the end of the air-pipe being closed by a cock or check-valve, which also serves for the purpose of ignition. To enable the engine to take a charge of air immediately on starting, without displacing the contents of the air-pipe D and silencer D^1, another check-valve is sometimes attached near the engine air-valve C, to admit air direct from the atmosphere; and this check-valve is closed when the engine has started. The valve is similar to B, and opens directly to the atmosphere. The exhaust-pipe may be similarly utilized as a starting-chamber; and either the exhaust or inlet valve (as C) of the engine may be so connected to its respective valve-actuating gear E, as to serve instead of the check-valve communicating with the cylinder. As shown in fig. 1, for example, the valve C would serve instead of the valve B, if the spring holding it to its seat is not too strong.

The arrangement shown in fig. 1 serves equally well to illustrate the use of the exhaust-pipe and its silencing-chamber for starting. In that case, C would be the exhaust-valve, actuated by the lever E and cam F; and D the exhaust-pipe, while D^1 would be the exhaust silencing-chamber.

Instead of using a long pipe as the chamber, according to another modification of the invention, the chamber is arranged as a cylinder G (fig. 2), having in it a piston, propelled by a low-pressure explosion on one side of it, to compress a charge of gas or vapour and air on the other side of it into the engine cylinder or combustion space A, there to produce a high-pressure explosion to start the engine, when ignited by any known means. This piston may be operated by a hand-lever L, so as to act as a pump to charge both the engine-cylinder or the combustion space and the chamber-cylinder. It thus acts with a mixture of gas and air; suitable lift or other valves being applied, to enable the charge to be taken in. Ports are shown under and above the piston, having lift-valves which admit gas and air beneath and above. When it is desired to charge the cylinder G and the space A, gas is shut off from the lower valve and turned on the upper one. The combustion space A is opened to atmosphere or exhaust, as described in the patent of 1891; and the lever L is operated to raise the piston. Air enters under it; and the gases above it are expelled through the valve B and through the space A. On lowering the piston, gas and air are taken in at the upper valve, and fill the cylinder, so that, on another up-stroke, gas and air pass through the valve B into the combustion space A. When a sufficient amount of air and gas has been pumped into G and A, the piston is allowed to fall to the bottom of its stroke. The plunger H has a recess opening at the bottom of its stroke to an aperture, which serves to discharge the contents when required. When the piston in G is moved up again, gas and air are admitted under it and ignited.

The ignition of the charge propelling this loose piston may be effected by causing the piston to pass over a hole controlled by a flap-valve K, and drawing in a flame from a Bunsen burner. When the piston has risen to the top of its stroke, and compressed gas and air through the check-valve B, it may overrun a port or channel in the side of the cylinder, which permits the flame under it to extend above it—passing into the engine-cylinder through the check-valve B, and igniting the compressed mixture therein to give a high-pressure starting explosion. A tube igniter M may explode the charge when compressed.

Instead of a single chamber D or long tube, the patentee sometimes arranges a number of chambers in series, with check-valves between each; so that the explosion in the first passes to the next—compressing from chamber to chamber until a very high pressure is attained, and a high-pressure explosion is then produced. This device is useful when a very high-pressure explosion is desired as a starting explosion.

Gas-Engine.—Binns, J. P., of Halifax. No. 13,859; July 30, 1892.

The patentee proposes to make the motor cylinder of his gas-engine longer at the compression end; and with this lengthened part (the charger) is placed a piston which, by means of a screw and wheels, or other suitable devices, is moved forwards and backwards as required. There is a stop-piece to prevent, when necessary, the charger-piston being moved into the compression-chamber.

The function of the charger-piston is: First, to force out of the compression chamber all the old mixture by opening the outlet-tap, removing out of position the stop-piece, moving forwards towards the compression chamber the motor piston at the end of its stroke, and moving forwards the charger-piston until it occupies the whole of the compression chamber. Secondly, the charger-piston draws into the compression chamber and into the charger, a fresh supply of explosive mixture, to accomplish which it is only necessary to close the outlet tap and open the inlet passages, moving backwards the charger-piston to the required extent. Thirdly, the charger-piston compresses the combustible mixture until it explodes. To accomplish this, the stop-piece is put in position, and the inlet passages are closed. Then the charger-piston is moved forwards quickly, thereby forcing the explosive mixture out of the charger into the compression chamber, and into the red-hot ignition-tube. Next, the crank is moved forwards from its dead centre; thus the explosive mixture is released, and is no longer under control. Therefore it explodes or expands; and the engine starts.

Manufacture of Gas.—Gray, J., of Bradford, Penn., U.S.A. No. 23,419; Dec. 20, 1892.

The purposes of this invention, generally stated, are "to secure a continuous flow of gas from gas-generators, in distinction to the intermittent flow heretofore attained; also to locate the retorts inside the generator, so that they may be heated by the waste heat from the gas-producing fuel." The patentee specially points out that his invention is applicable "to the manufacture of all ordinary kinds of heating and illuminating gas, except 'straight' coal gas."

The principal claims for the invention are: (1) In gas-producing apparatus, the combination of a gas generator; one or more retorts located in the combustion chamber of the generator, and communicating with the combustion chamber; a valve controlling the communication between the combustion chamber and the retort or retorts; a pipe connecting the bottom of the generator with the retort or retorts, controlled by suitable valves; and a blast-device connected with the upper and lower parts of the generator and valves in the blast connections. (2) In gas-producing apparatus, the combination of a gas-generator; a blast-device connected with the upper and lower parts of the generator; gas connections from the upper and lower parts of the generator to a second gas-generator; and one or more retorts located in the combustion chamber of the second generator, and communicating with the combustion chamber—the whole system being provided with suitable valves.

Water-Meters.—Westinghouse, G., and Ruud, E., of Pittsburg, U.S.A. No. 6049; March 21, 1893.

The object of this invention is to provide a volumetric appliance for water or other liquids, which, by reason of its structural and operative principles, shall afford, "as fully as practicable, the resultant advantages of accuracy in measurements and durability of its parts." To this end, say the patentees, their invention, generally stated, consists in the combination of a piston chamber, provided with inlet and discharge ports; a piston fitting, without axial bearing, in this chamber, so as to have the capacity of diametrical traverse therein—the piston rotating about its own axis in, and rolling peripherally on and around, the

inner surface of the chamber, and being provided with ports adapted to register alternately with the inlet and discharge ports of the chamber; and a series of abutments fitting in the piston, and against the piston chamber.

APPLICATIONS FOR LETTERS PATENT.

11,995.—Clough, G., and Hall, H., "Heating steam generators, using as a fuel coal gas and air." June 19.

11,997.—The Scottish Gas-Stove Company and Darwin, S. B., "Gas cooking stoves, ranges, and the like." June 19.

12,029.—Schneider, G. A. E., "Incandescence bodies for incandescent gas-lamps." June 19.

12,036.—Day, J. J., and T. I., "Igniting-tubes for gas or petroleum engines." June 19.

12,084.—Fiddes, W., "Charging gas-retorts." June 20.

12,092.—Crane, H., jun., "Gas and other engines deriving impulse from explosion." June 20.

12,183.—Hamilton, J. H., "Gas motor engines." June 21.

12,184.—Brownhill, R. W., "Automatic sale and delivery coin-freed attachments for gas and liquid meters." June 21.

12,294.—Earnshaw, A., and Oldfield, T., "Gas or other explosion engines." June 22.

12,355.—Young, W., "Production of illuminating gas from mineral oils, and apparatus therefor, and for producing water gas." June 23.

12,384.—Barralet, T. E., "Automatic gas-valve and regulator for water-heating apparatus." June 23.

12,427.—Dougill, J., "Gas and explosive vapour motors." June 24.

12,434.—Hatton, H., "Self-starter for gas and oil engines, &c." June 24.

12,440.—Mond, L., "Obtaining combustible gases, ammonia, and tar from fuel." June 24.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by our correspondents.]

Wages of Workmen.

Sir,—The profit-sharing system of the South Metropolitan Gas Company, if generally adopted, would doubtless be very beneficial to most large companies; but it is very doubtful whether it would be so to small ones. When we consider the present state of the gas interests, and, in fact, of labour generally, as no one can foresee what the next movement may be, it is impossible to doubt that it is desirable some arrangement with the workmen, partaking of the profit-sharing system, ought to be adopted.

Under all occupations, except that of daily labour, men look forward to getting, in their old age, especially after being many years in the same establishment, something more than they had at the beginning. But, on the contrary, it unhappily often happens that, instead of being rewarded, they are sent adrift for others younger and more active, although the doing so may be a very mistaken notion; for an old and reliable workman can do more real service by giving his attention when, and only when, it is required, than another who does everything by time.

I am not sufficiently acquainted with the profit-sharing system to know precisely how it works. But it seems to me that there is no selection allowed to the Company, but that any man may put himself under the arrangement who thinks fit to do so; and thus the Company may as often get a careless and negligent man as a good one.

The unjust removal of workmen it is, of course, impossible to regulate. It must be left to the better feeling of the employers themselves. But, in large establishments, working under the regulations of Parliament, it might be, and in the interests of the establishments themselves ought to be, regulated differently. Apart from a man's regular wages, a separate allowance might be granted as "good conduct money," and any man who has been in a company's employment continuously, and his conduct approved of for (say) 5 years, be allowed, as good conduct money, 1s. per week; after 10 years, 2s.; after 15 years, 3s.; and after 20 years, 5s. per week—more or less as might be previously arranged. It might cost a trifle more, but very little; and, even if it did so, it is hardly conceivable that consumers would object. I know of nothing in gas regulations to prevent any company adopting such a course at once, without any special powers for the purpose.

Now that the working man has been taught to read and think for himself, his interest will have to be dealt with in a very different way from what it has been hitherto.

July 1, 1893. Wm. Livesey.

"The New Method of Charging for Gas."

Sir,—Your correspondent, Mr. Livesey, does not, in the Journal for June 27, seem to make any special allusion to "the new method of charging for consumption of gas;" yet he may be referring to it when he states "that to divide the price of gas into two or more separate items is impracticable, and contrary to all precedent in this country"—otherwise I cannot bring uppermost to my mind what division is referred to. In the Journal for June 20, it was reported that at Stratford-on-Avon prices were fixed at 3s. 6d., 3s. 4d., and 3s. 2d. per 1000 cubic feet; and several gas companies have varying prices. I also have before me a prospectus of a gas company, recently launched, wherein there is offered a "bonus" to consuming-shareholders of a reduction of 1d. per 1000 cubic feet, up to a maximum quantity, and which allowance is to be increased to 5d. per 1000 cubic feet on a *sliding scale* of increased dividends.

It is these different prices, or discount allowances, or unnecessarily high or increased prices in certain areas or districts for the one monopoly-supply—gas—that gives consumers a reason to complain; and other reasons might be given. Naturally, where discounts are allowed by gas companies that adopt the sliding scale, shareholders have a right to demand increased dividends. A uniform price over a fixed area of supply seems to be the right policy for gas companies—correct in principle, and best for practice or profit. A manufacturer sells goods with a discount that is to represent all or part of a retailer's profit; but a gas company supplies gas that is only a sale when it is consumed, or made use of, by consumers. Therefore a fixed price should not have any abatement at the time of payment.

If gas be charged at 2s. 6d. per 1000 cubic feet, a discount of 5 per cent. makes the cost-price 2s. 4½d. Consequently, there can be no gainsaying that all discounts do make the cost price lower—*i.e.*, an allowance in the price. It has been reported that a gas company did allow 5 per cent. discount so as not to displease a large consumer; and another gas company did make a special price to a large consumer, so as to supply him with gas, instead of letting him make his own.

When gas managers say that a higher price should be charged beyond a certain distance, because of the extra expense of laying the mains, &c., there seems a justifiable reason for having separate prices for in and out of border lines. But when your correspondent repeats the decision or opinion of a Judge, that "freight carried over long distances may be carried at a reasonably less rate per mile than freight transported for shorter distances, simply because it costs less to perform the service," and then avers that "this applies with equal force to gas supply," I must admit I do not comprehend where the sense of the application comes in. Where is the analogy? Expenses for collection of accounts bear no comparison to charges for conveyance of goods.

With the exception of one county, I assume that gas companies generally charge meter-rents for meters they supply, which with stove-rents appear a good business for them. Therefore there need be no necessity to think about increasing the charge for services rendered by gas companies in collecting their small accounts.

Although your correspondent jumps to the conclusion that "'Fio' cannot have had much experience in gas supply," still I maintain that the deposit system is worthy of consideration, and perhaps a fixed interest of 3d. in the pound per quarter allowed off the gas bill might be applicable. As to prepayments offending every substantial customer, does not the success of the Civil Service Supply Association and the Army and Navy Stores refute such an idea? And does not the increasing demand for prepayment meters in Liverpool and other towns point to ready-money customers who avoid being offended?

That a "bonus" to the staff of working men is agreeable to your correspondent's views is satisfactory. But I may mention that what remains in my memory of the reports I read is, that I did not agree with the details in the proportioning of the profit-sharing scheme of the South Metropolitan Gas Company; and really I cannot discern how justice can be enacted to a working-staff, while a company have excessive management expenses, and pay dividends above 10 per cent. under a sliding scale.

I agree that "equitable treatment is a long step towards popularity;" but popularity is not everything. Judgment is forced on us by experience; and, in my opinion, although discounts are a simple method for reducing prices of goods, yet it would not be a method adopted for a dinner *à la carte*, after it had been consumed; and I consider discounts a most unsatisfactory method for monopoly gas companies to adopt, as it enables them to favour, or be popular with, large or special consumers of gas, under the guise of "equitable treatment."

London, June 29, 1893. Fio.

Carbon Deposits on Gas-Burners.

Sir,—In the "Technical Record" in the issue of the Journal for June 27, there is a communication under the above heading, in which I observe it is stated that "the remedy commonly applied is to cut out the deposit with a fine saw or steel ribbon." The plan in use by the Bristol Gas Company, from the introduction of steatite burners for public lighting up to the present time, is to burn the carbon away. As it may possibly be of service to someone, I will describe the method I adopted some years ago, by which means many thousands of burners have been treated, time after time, without injury in any way. A suitable means of support was arranged, so that a number of governor burners could be laid in a horizontal position upon it, with the steatite tips nearly touching each other, while the governor ends radiated like the spokes of a wheel. A Bunsen burner was placed beneath the small circle formed by the tips, so that the outer cone of the flame played equally upon each. A minute or so sufficed to burn the carbon away; and the burners were then removed to cool. The nipples, when cool, should have no appearance of blackness, and the passage of a piece of paper or a brush across the slits is all that is necessary to render their efficiency equal to that of new steatite tips.

Bristol, June 30, 1893. W. Fiddes.

"Hawkite" Gas.

Sir,—I notice a letter on the above subject in your issue for June 27, signed by the Secretary of the Hawkite Company, giving a copy of a report on this process, which he alleges was drawn up and signed by me, in conjunction with two others. It was in consequence of this report that I wrote my first letter, which was published in the Journal for June 13; and also because of another report which the Secretary has not mentioned or given a copy of in his letter.

After making an experiment with the hydrogen carburetted with paraffin oil, with the three-horse power (nominal) "Griffin" gas-engine, the particulars of which I gave in my letter of June 13, I had communicated the bad results obtained to the Managing-Director of the Company. He then requested me to draw up a report, giving all the best results obtained during my experience with this process; but he added, "for goodness sake do not say anything about the bad results." The date of the trial with the carburetted hydrogen was on April 18, 1893. I consulted with the two others who signed the report, on this same date; and it was decided what I should write. That same evening, I drew up a report, somewhat different to the one quoted in the Secretary's letter, which I presented to the Managing-Director the next morning. He rejected it; and drew up in his own handwriting what we should say. I have a copy of the original report in my possession, together with the alterations in the Managing-Director's own handwriting.

My first report commenced: "We, the undersigned, have experi-

mented with Hawkite gas, and have obtained the following results, &c." The words in the second report drawn up by me, commencing with "We, the undersigned, have pleasure in submitting the following report after *elaborate and careful investigation* of the above gas, &c.," are the Managing-Director's own words, which I have in his handwriting, and was entirely his own suggestion, as indeed a great deal of the report which followed, of which I have a complete copy. As to the following sentence in the report—viz., "There is practically no waste in the production of the gas, as the bye-product, which consists of sulphate of iron (ferrous sulphate, copperas, or green vitrol), is a marketable and useful article, readily finding sale in London at about £2 per ton; and we believe a much higher price can be obtained in country districts. From 1 ton of iron consumed, and 1¾ tons of concentrated sulphuric acid required for its consumption, the yield of gas is over 12,000 cubic feet, and the crystallized sulphate of iron is over 4½ tons in weight. This bye-product is largely used for deodorizing, dyeing, manufacture of ink, &c."—this was entirely drawn up by the Managing-Director of the Company, and arranged entirely by him. His draft, I have in my possession—in fact, most of the report was rearranged and drawn up by him, which I was foolish enough to have copied out and put my signature to. The date of this final report was April 19, 1893.

In my original report, I said nothing about the quantity of sulphate of iron crystals produced, or its market price; but it may be pointed out that the price of the sulphate quoted above—vix., £2 per ton, as given by the Managing-Director—must have deducted from it the cost of delivery, packing, &c., when not any more than, if as much as, 35s. per ton will remain as the actual amount obtainable for the sulphate of iron crystals. This will agree with the price given in my letter of June 13.

The Managing-Director also made me draw up and sign another report for the Secretary of the Company, *giving only the best results* I had obtained during my investigations as to the quantity of sulphate of iron crystals produced per ton of iron consumed, and the yield of hydrogen gas. It was in consequence of these two reports that I wrote my letter to the JOURNAL, giving my true opinion of the process, as I feared that the Hawkite Company would circulate these two misleading reports when I was not there to modify them; for, as stated in my letter of June 13, this "Hawkite" process is most deceptive and misleading. If any competent and independent expert were employed to report on the process, I am perfectly confident that his report would be no better than that contained in my letter of June 13.

The statement that, while I was in the service of the Company, "I always spoke and wrote of the Hawkite invention in the highest terms," I positively contradict, as I can bring witnesses to prove to the contrary. But, of course, as long as I was in the service of the Company, and was receiving money from them, I could not openly express my opinion. I may, however, add that all the statements contained in my letter of June 13 were well known to the Managing-Director of the Company, to whom I always duly reported all results, good or bad, at the time of observation. But it is probable that he thought the same as, when I pointed out to him the high consumption of hydrogen, or "Hawkite," gas, in comparison with coal gas, in connection with the Welsbach incandescent burner, he cooly remarked "that it was a pity that we knew this fact."

It was only on the complete investigation of the process by myself, and after I had drawn up and signed the two reports before mentioned, giving all the good results and none of the bad, at the Managing-Director's request, that I was abruptly informed that the Directors of the Company had decided that they could dispense with my services. It appeared quite obvious to me what their intentions were; and it was for this reason that I publicly declared my true opinion of the process.

I may add, in conclusion, that I have in my possession a full account of all the experiments and trials conducted by myself and others, together with the respective dates of observation, in connection with the complete investigation (which extended over eleven weeks) of this "Hawkite" process; and I can produce them any time when called upon to do so.

June 27, 1893. EDWARD J. M. DAVIES.

Electric Lighting for Cardiff.—Last week tenders were accepted by the Electrical Committee of the Cardiff Corporation for the principal portion of the machinery and plant required for their electric lighting installation—the total amount being £10,200.

Sales of Shares.—About 100 shares of various classes in the *Heckmondwike Gas Company* were lately sold by auction at the following prices: "A" shares, at £11 12s. 6d.; "B" shares, at £4 17s. 6d. "C" shares, at £8 15s.; and "D" shares, at £7 7s. 6d.——At a recent public sale at Southsea, some £5 shares (1883 issue) in the *Portsmouth Water Company*, on which £4 has been paid, realized £8 each, and similar shares, on which £3 10s. had been paid, fetched £7 10s.

Coleraine Gas Supply.—At the recent annual meeting of the Coleraine Town Commissioners, the retiring Chairman (Mr. R. A. Taylor, J.P.), in the course of his remarks, bore testimony to the excellent condition of the gas-works, which are under the management of Mr. W. S. Stormonth. He stated that the works were in most excellent order; and it was gratifying to him to know that the Board had considered their present position and prospects so good that they had arranged to make a substantial reduction in the price of gas. Although they had a good deal of money to expend in the renewing of mains—which would probably require £500 or £600—he had no doubt that, with the cheaper coals they were now buying, and the possible increase in the consumption of gas, the outlay in this direction would be met without any difficulty. In the meantime, the consumers would have the satisfaction of obtaining it at a reduced cost; and he had no doubt that Coleraine would be supplied with gas at a lower rate than any other town in Ireland of similar size. At the close of Mr. Taylor's remarks, he was unanimously re-elected Chairman of the Commissioners. It may be mentioned that the reduction in the price of gas referred to by him is the second in the course of four years. The first was from 5s. to 4s. 2d., and the present one to 3s. 9d. per 1000 cubic feet.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Bills last week:—

Bill read the first time, and referred to the Examiners: St. Helens Corporation Bill.

Bills read a second time: Electric Lighting Provisional Order Bill (No. 7); Greenock Corporation Bill; Water Provisional Orders Bills (Nos. 2 and 3).

Bills read the third time and passed: Barnoldswick Local Board Bill; Bodmin Water Bill.

Bills Royal Assented: Barry and Cadoxton Local Board Bill; Blackpool Improvement Bill; City of London Electric Lighting Bill; Devonport Water Bill; Electric Lighting Provisional Orders Bills (Nos. 1 and 4); Pontypridd Local Board Gas Bill; South Staffordshire Water Bill; Todmorden Local Board Gas Purchases Bill; Water Provisional Orders Bill (No. 1).

A petition was presented against the Water Provisional Orders Bill (No, 2). in respect of the Newington Order, from the Hull Corporation.

HOUSE OF COMMONS.

The following progress was made with Bills last week:—

Bill read the first time, and referred to the Examiners: Gas Orders Confirmation Bill.

Bills read a second time and committed: Belfast Water Bill; Frimley and Farnborough District Water Bill; Gas Orders Confirmation Bill.

Bills reported: Bilston Commissioners (Water) Bill; Crystal Palace District Gas Bill; Electric Lighting Provisional Orders Bills (No. 5 and 6).

Bills read the third time and passed: Pontypridd Local Board Gas Bill; St. Helens Corporation Bill; Weaver Navigation Bill.

Bill withdrawn: Goole and District Gas and Water Bill.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Wednesday, June 28.

(*Before Mr. Justice* COLLINS.)

Perkins v. Wright and Co.—Action Regarding a Contract for Water-Meters.

This was an action by the assignee of a patent for water-meters against an engineering firm for not performing a contract for supplying them. Plaintiff alleged that on Sept. 2, 1890, defendants contracted to supply to him, within three months of that date, 100 water-meters made in accordance with the patent, on which contract he had paid, he said, to them the sum of £100 for making patterns of, and fixing indexes to, such meters; and, by reason of the defendants' failure to perform their contract with him, the plaintiff said he had lost this sum, which he claimed to recover. He had also lost the profits he would have made by the sale of the meters and the work done; and the patterns and materials had become useless to him. The defendants denied the alleged contract, and also that the work and materials had become useless; and they set up a counterclaim for work and materials and expenses incurred to the amount of £150, upon which, giving credit for the £100 paid, they claimed £50.

Mr. CRUMP, Q.C., and Mr. BLACKWELL appeared for the plaintiff; Mr. M'CALL, Q.C., Mr. T. ROSE-INNES, and Mr. G. JOSEPH represented the defendants.

A co-owner of the patent, who had carried on the communications with the defendants, was called to prove the contract, which did not stipulate that the meters were to be according to the specification of the patent of one Tiedman. Of the total number of meters, 50 were to be delivered in a month; the rest within three months. Witness was cross-examined as to the patented meter and its efficiency. The meters, he said, were intended to be put underground; and it was essential that they should register continuously and correctly the water supplied. This the patented meter did not do. A meter was sent to the East London Water-Works; and it was found that the index did not work properly. The meter stopped working; and the defendants, in July, 1891, wrote that the meter was not effective. In March, 1892, witness wrote to the defendants that the "index was still the stumbling-block;" and in May he wrote that the report received from the East London Water-Works still showed that the meter was defective.

Mr. CRUMP, for the plaintiff, objected that all this evidence was irrelevant. The contract was to make meters according to the contract; and the cross-examination was directed to show that the meters, if made, would have been useless.

Justice COLLINS said the evidence would be material as to damages. The plaintiff claimed damages for non-delivery of the meters in due time; and this went to their value. So also it might tend, perhaps, to show a mutual exoneration—that is, that both sides, finding the inventions valueless, agreed to drop the contract.

Mr. CRUMP said the cross-examination raised a scientific question as to the defects in the meters. The question was simply whether the meters had been made and supplied according to the contract.

Justice COLLINS said the question was whether the meters supplied were made according to the contract; and, if so, it would not be material whether or not they were workable.

In further cross-examination, witness stated that in September, 1892, the meter stopped. He denied saying that it would be useless to go on; but he admitted remarking that, unless the meters were supplied, the order must be cancelled. The 100 meters were not supplied—only one as a specimen to be tested; and he then cancelled the order.

In re-examination, witness stated that meters had been made according to the patent, and had worked satisfactorily for 18 months. The defendants had not delivered a single meter, made according to the contract, two years after the contract; and hence the action.

Mr. *W. B. Bryan* gave evidence as to the nature of the patent. He said there was great difficulty in making water-meters effective; and they were therefore subjected to severe tests. He had been prepared to give, on the part of his Company, orders for a number of those meters which stood the tests. The meter in question had not become a commercial success.

Mr. M'CALL contended that the order was given on the condition that the patented meter was workable; and, as it was found not to be so, the order was cancelled.

Mr. *Wright*, one of the defendants, was then called, and stated that early in 1889 he made three meters according to Tiedman's patent; but they were found to be useless, and were broken up. He then made another meter with alterations; but this also was unsatisfactory. (From the correspondence, it appeared that the object desired was to pass 300 gallons of water an hour.) He sent to plaintiff his account for all this work in August; and no fault was ever found with it. He then stated the circumstances of the alleged contract in September, 1890. He was asked, he said, to give a price for 100 meters, and did so; and then he received an order for 100, provided they could be made perfect. He then sent in his account for the work done, which was for £150; and received a cheque for £100, which he objected to. The excuse made by plaintiff was that he was "short of cash." He wrote confirming a guarantee to amend within six months all faults due to defective workmanship; and he suggested the appointment of an independent authority to test the meters when delivered. It was not settled what precise kind of meters were to be made. He submitted to plaintiff a drawing of one which he suggested, and he had made the various parts; but there had been no decisive approval, and there had not been before March, 1891, any urgent request to him to proceed with the meters. In March, 1891, he had a letter asking when meters would be ready for delivery, as orders could be obtained if some could be supplied. He had made a new meter, and simplified the construction as much as he could; and it was ready for testing in 1891. But in June it was found that it did not work well. He did his best to remove the difficulties; and he had repeatedly seen the plaintiff and explained the different parts to him, and asked for a decisive answer as to what was to be done, but could not obtain it. He had explained that it was impossible to work the meter so as to satisfy the proposed conditions; and on Oct. 5 he received a letter cancelling the order.

In cross-examination, witness said the contract was not carried out, because he could not make a workable meter; or, rather, because the plaintiff would not approve of a meter as workable. He should have considered it a mere trick to turn out 100 meters which would not work; and meters made according to the specification would not act.

Justice COLLINS pointed out that the order for the 100 meters did not refer to the specification. It had already been found that a meter made according to it would not work, and modifications were suggested, and while these were pending the order was given.

Witness admitted that he had been shown a Tiedman's meter, which, he was told, had been at work for 18 months at the East London Water-Works. But he did not know this; and, when he saw it, it was out of order.

In re-examination, witness said Mr. Bryan demanded a meter which would work equally at high and low pressure, and work at a flow of 300 gallons an hour. This was the object of his experiments; and he could not succeed in producing such a meter.

After a long trial,

Justice COLLINS gave judgment for the plaintiff on the claim, and for the defendants on the counterclaim.

Extensions at the Southampton Corporation Water-Works.—The Southampton Town Council at a recent meeting resolved, on the recommendation of their Water-Works Engineer (Mr. W. Mathews, M.Inst.C.E.), to erect another pumping-engine and engine-house at the Otterbourne Water-Works, at an estimated cost of £10,000; to provide for the supply of water for road watering and sanitary purposes, by constructing increased headings at Otterbourne, at a cost of £500, and additional softening plant at a cost of £800, being a total outlay of £1300; and to renew, during the next six years, mains in the borough, at the rate of three miles per year, at a cost of £750 per mile.

Ventilation, Heating, and Lighting.—A series of lectures has lately been given, in connection with the Sanitary Institute, in the Technical School, Dublin. In the course thereof, the above subjects were dealt with by Sir Douglas Galton, K.C.B., F.R.S., who, in the course of his remarks, asserted that coal, notwithstanding its imperfections, was the cheapest and most convenient means of obtaining heat. A gas-fire, he said, produced a less temperature in the chimney, and did not assist ventilation in the way a coal-fire did. A pound of coal required for its combustion 300 cubic feet of air, having a temperature of 620° Fahr. If the air supply to a coal-fire was insufficient, the combustion was imperfect, impurities were thrown into the atmosphere, and much of the heat evolved from the coal was lost. The merits of gas, candles, and other illuminants were discussed; and the lecturer stated that he considered the incandescent electric light was the most hygienic form of light.

Suggested Acquisition of the Neath Water-Works by the Corporation.—Negotiations are on foot for the purchase of the Neath Water-Works by the Corporation. The statements made by those who are in favour of the transfer represent the Company in a good position. It is claimed that the gathering-ground from whence the supply is obtained is excellent, the streams passing through but little arable land; and further that, with due storeage, there would be abundance of water for 100,000 people. The sum named by the Company for which they will part with the undertaking is £47,000; and this is not considered excessive. The Company hold a 99 years' lease on the land on which the filter-beds are constructed; and there is a clause in the lease that, should they sell their undertaking to the Corporation, the land will revert to the lessor (Mr. C. E. Thomas), who, it is anticipated, will not be unreasonable in his demands. The Company have offered to refer the question of the value of the works to arbitration; but the Corporation are urged to take the simpler course of dealing direct with the Company.

MISCELLANEOUS NEWS.

SOUTH METROPOLITAN GAS COMPANY.

An Extraordinary General Meeting of this Company was held last Wednesday, at the Bridge House Hotel, London Bridge—Mr. GEORGE LIVESEY in the chair—for the purpose of electing a Director in the place of the late Mr. John Mews.

The SECRETARY (Mr. Frank Bush) having read the notice convening the meeting,

The CHAIRMAN said it was with great regret that the Directors met the shareholders on this occasion. Death had been very busy among them. They lost their old friend Mr. White only last year; and now they had lost their worthy Deputy-Chairman. Mr. Mews was a gentleman whom they all greatly respected; he believed he might also say they regarded him with affection. His ripe experience, his calm judgment, and his amiable temper rendered him a very great acquisition to the Board; and they felt his loss very keenly—indeed, he believed he might say they felt the father of the Board had gone. They had now to perform the duty of filling his place. There were not many gentlemen among the shareholders who had notified their intention of coming forward as on the last similar occasion; and the first application in both cases as it happened was by a gentleman in every way suited for the position. He could say, with regard to the last election, that the short experience they had had of Mr. Cardwell had shown that they had made a real acquisition to the Board; and they were glad to find they had so good a Director in the shareholders' last choice. Now he had to bring before them the name of another gentleman, who was not new to gas matters—Mr. Benjamin Leigh Smith. Some years ago—perhaps 15 years—he was a Director of one of the most successful Gas Companies in London. It was the Independent Company; and, although only a small concern, it sold gas at as low a price as any other Company, and was one of the most successful and prosperous. That Company was absorbed by The Gaslight and Coke Company; and Mr. Smith was elected as the representative of the interests of the Independent Company on the Chartered Board. He would not have been so selected if he had not been considered the best man to send from the Independent Company's Board. Apart from his knowledge of gas matters, his career had shown that he was a gentleman of very great fertility of resource and force of character. He (the Chairman) had much pleasure in proposing—"That Mr. Benjamin Leigh Smith be elected a Director of this Company in the place of Mr. John Mews, deceased." He might add that Mr. Smith had made a reputation as a great Arctic explorer; but this some shareholders might say was no recommendation as far as a Director of a Gas Company was concerned, He, however, thought that a man who could go through the work Mr. Smith had was sure to make a good Director.

Mr. T. GUYATT seconded the proposition, which was at once unanimously agreed to.

Mr. SMITH, in returning thanks for the honour the shareholders had done him, remarked that he could not help feeling he should fill very inadequately the vacancy that had arisen through the death of their late Deputy-Chairman. It was some years since he had had anything to do with gas companies; but, under the able guidance of their Chairman, everything would go straight. He certainly thought it would be a great honour to serve under Mr. Livesey, and to be on the Board of such a prosperous and well-managed Company.

The CHAIRMAN said it would perhaps interest the shareholders to know that their business continued to increase, notwithstanding all the difficulties they had had to contend with.

This concluded the proceedings.

PLYMOUTH AND STONEHOUSE GAS COMPANY.

The Annual General Meeting of this Company took place last Thursday—Mr. G. HENDERSON in the chair.

The report presented by the Directors stated that, after paying the authorized half-yearly dividend in January last, there remained to the credit of the profit and loss account the sum of £19,821; and they now recommended a dividend for the six months ending the 31st of March last of 12s. 3d. per share on the original shares, 9s. 9d. per share on the additional shares, and 9s. 3d. per share on the new shares issued under the Act of 1879, free of income-tax. This would absorb £5522, and leave £14,299 to be carried to the credit of the next account. The reserve fund now stood at £16,145. With regard to the works, the Directors stated that they had entered into contracts for the erection of a new retort-house, the construction of a gasholder tank, and the addition of a third lift to a gasholder; and, when the new house was completed and in action, they had every reason to expect that a considerable saving would be effected. To meet this outlay, it would be necessary to issue the remaining portion of the share capital authorized by the Company's Act of 1879, and also to exercise the borrowing powers contained in that Act.

The CHAIRMAN, in moving the adoption of the report, reminded the shareholders that the Company had occupied an exceptional position for many years. The Directors had invariably endeavoured to carry out the object for which the Company was formed—viz., to supply gas at the lowest possible rate. During the past four or five years, the increase in the cost of coal and labour had caused the gas companies in London and many large towns in England to raise their price and reduce the dividends; while the Plymouth Company had been contented to supply gas at the extremely low price of 1s. 9d. per 1000 cubic feet. After paying the dividends now recommended, there remained as undivided profits the sum of £14,299, and a reserve fund of £16,145. He thought the shareholders would agree with him in saying that the affairs of the Company were in a sound and satisfactory condition. The three months' strike among the Durham miners last year cut off the usual supply of coals; and the Company were consequently obliged to draw their supplies from Scotland and other places. In this way, about 8000 or 9000 tons had been purchased at an increased

cost; the additional expenditure entailed being £1250. It was, of course, a matter over which the Directors had no control, and which he hoped would not occur again. He was pleased to intimate that the contracts entered into for the current year were very advantageous. Last winter was a comparatively mild one; and mild winters affected the Company by restricting the consumption of gas and by reducing the demand for coke. But, notwithstanding the increased price paid for coals, owing to the strike referred to, there was a balance of £8450 to be carried to the profit and loss account, as compared with £8777 last year. The extensions which were referred to in the report were absolutely necessary. They had involved an outlay of £16,217; and, as a set-off, premiums to the amount of £12,500 had been received. The retort-house about to be erected was 254 feet long by 64 feet wide; and, when in working order, it would turn out about the same quantity of gas as the other four houses now produced. The result would, he thought, justify the expense incurred. There had been laid during the year something like 1½ miles of mains; and about 300 new consumers had been added to the list. The large outlay he had referred to would for some years diminish the undivided profits; but he ventured to say that, when the whole of the works had been completed, a very considerable saving would be effected.

Mr. R. H. SNOW seconded the motion; and it was carried *nem. dis.*

Resolutions authorizing the payment of the dividends recommended were then passed, and other formal matters disposed of.

The retiring Directors and Auditor having been re-elected,

The CHAIRMAN submitted a resolution authorizing, under the provisions of the Plymouth and Stonehouse Gas Act, 1879, the issue of the remaining portion of the share capital, amounting to £35,000, in shares of £10 each, and also to exercise the borrowing powers contained in the Act, and to empower the Directors to do such acts as might be required to give effect thereto.

Mr. SNOW seconded the motion; and it was carried.

A vote of thanks was then accorded to the Chairman and Directors.

The CHAIRMAN, in acknowledging the vote, remarked, in reference to an observation by a shareholder as to the electric light adversely affecting the Company in the future, that it would not be much of an opponent while the Company supplied gas at 2s. per 1000 cubic feet. He explained that, for every 1d. they reduced the price of gas, the shareholders received £250, and the consumers £2000. Therefore, during the past nine years, the latter had benefited to the extent of £18,000, while the Company had only gained £2000.

A vote of thanks was passed to the Secretary (Mr. J. Thomas), the Engineer (Mr. H. Townsend), and the other officers of the Company, and the proceedings closed.

INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

The Annual General Meeting of this Company was held last Friday, at the Cannon Street Hotel, E.C.—Admiral Sir EDWARD INGLEFIELD, K.C.B., in the chair.

The SECRETARY (Mr. L de Fonblanque) read the notice convening the meeting; and the report and accounts for the year ending March 31 last were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, congratulated the shareholders on the largely increased business, as compared with the previous twelve months. As shown in the item of "sundry sales," the business exhibited an increase of about 100 per cent.; while the factory wages, fitters, &c., were almost identical. They would naturally inquire why, notwithstanding this, a loss resulted on the year's working. The reason was that the business was one with so much detail that it could not be worked on a small scale; and a turnover of less than £20,000 did not pay expenses. A larger business could have been done, and would have been done, but for difficulties against which the Board could not provide. Trouble arose through having an insufficient supply of lighting fluid, owing to the Company being under an obligation to supply the French and Italian Companies. Had it not been for this, they could have done three and even four times as much business. A recurrence of these difficulties, however, could not take place, as they had put themselves in a position to command whatever quantity of fluid they might require; and, should one source fail, they could always obtain supplies from another. The shareholders, he remarked, must not expect results equal to those said to be obtained in Austria and Germany, as more favourable conditions in those countries must be taken into consideration. In Berlin and Vienna gas was about twice the price that it was in London; and this made an economical burner a very great necessity in those cities. Then there was a much larger demand for brilliant illumination than there was in this country, where the majority of consumers were satisfied with the rudest form and poorest quality of light. The Minister of Instruction of Germany had issued a circular, recommending the adoption of the light at all the schools and colleges under his authority. With respect to the business done in oil-gas making machines, they had been working this branch very slowly; and the few installations they had made had been watched with great attention, in order that any slight difficulties which might be noticed in working the apparatus might be at once corrected. This had resulted in important improvements being made; and they had every prospect of doing a large business in this branch. They had now sold all the foreign patents for the lights, with the exception of that for the Cape of Good Hope; and the Directors were of opinion that the prices realized were very satisfactory. It was possible that, had they waited a little longer, they might have obtained better prices; but, on the other hand, they might not have sold them at all, besides which it must not be forgotten that half the life of the patents had run out. The foreign patents, at the beginning of the year under consideration, stood in their books at £11,500; and the sum realized upon them was above £30,000. The net result, therefore, of the year had been to wipe out a loss of more than £8000 from the previous year's accounts, and to show a profit of upwards of £8000, which they could not but consider was very satisfactory. The French patent was sold for 300,000 frs., of which 250,000 frs. was paid in shares, and the remainder in cash. The Belgian patent was sold for 200,000 frs., of which 50,000 frs. was in cash, and the rest in shares. The patents for Australia had been sold for £6000 in cash; and those for Spain and Portugal, for £7000. The patent for India was sold for £1000, which sum the Board considered was as much as it was worth, as the conditions of life in that country were not favourable to the adoption of the light. The new burner which they had now adopted (and which they would issue exclusively in the coming autumn) was being sold at 15s., and easily commanded the price; and this resulted in a considerably larger profit than they obtained on the 10s. burner. Having made reference to the arrangements they had entered into for pushing the sale of the lights, he stated that the Board did not consider it would be in the interests of the Company to pay away the whole of the profits in dividends; and in recommending the payment of about £3000, they believed they were acting for the best. The development of the business necessitated a corresponding amount of working capital; and they had therefore reserved some £3000 of the net profits for this purpose. The dividend recommended on each ordinary share was 2d., and on each preference share 6s. 4d. This considerable difference, he explained, was in accordance with the resolutions on the subject; the ordinary shares being entitled to one-tenth and the preference shares to nine-tenths of the amount of the profit. Every opportunity had been given to the shareholders to equalize their holding; and, if they had not responded, they could not now complain. The shareholders would remember that, at the last meeting, the Directors informed them that, having given their personal security in the discounting of the Italian bills—a measure which was absolutely necessary to save the Company from liquidation—they had taken a lien on 3500 debentures and preference shares, with the option of taking these up at par, and the bills be met in due course. They had since availed themselves of this option in so far as the preference shares were concerned; but they did not take up the debentures, as, by doing so, they would immediately have made the Company chargeable with the interest accruing up to Aug. 1 next, when the debentures were redeemable.

Major JONES seconded the motion.

A very long discussion followed; but it was not of general interest. Complaint was made that the expenses were excessive; and the Chairman's statement that there had been difficulties with the fluid was spoken of as a "stereotyped sort of phrase" at the annual meetings. One shareholder wondered what position the Company would have been in if the foreign patents had not been sold, and what will become of it after the remaining foreign patent is disposed of. Some very strong remarks were also made with regard to the preference shares which the Directors had taken, as explained by the Chairman at the close of his address—one gentleman declaring that, although the Directors had only held these shares six weeks, they would receive twelve months' profit. Major-General Beresford, Major Jones, and the Chairman satisfactorily defended themselves against the insinuation that they had made a good thing out of this transaction. The Manager (Mr. Moeller) also gave some additional information respecting the business arrangements.

The report was adopted, with two dissentients; and subsequently the dividends recommended were declared, the retiring Director (Major-General Beresford) was re-elected, and a resolution was passed (several shareholders abstaining from voting) raising the Directors' fees from £400 to £800 per annum.

The usual complimentary vote terminated the proceedings.

THE PROJECTED AMALGAMATION OF WATER-GAS UNDERTAKINGS.

As a step for carrying out the projected scheme of amalgamation, the Boards of the three Water-Gas Companies have, says the *Financial News*, authorized their respective Secretaries to enter into a provisional agreement with a trustee for the new Company, to which it is proposed to transfer all the assets and liabilities in each of the existing Companies, excepting the further unpaid capital, this being £1 per share in the British Water-Gas Syndicate, Limited, £1 10s. per share in the North British Water-Gas Syndicate, Limited, and £1 10s. per share in the Yorkshire and Lancashire Water-Gas Company, Limited. The name of the new Company will be the Amalgamated Water-Gas Companies, Limited, with a capital of £250,000, in 250,000 shares of £1 each, of which 200,000 shares, issued as fully paid up, will be distributed among the three existing Companies; leaving 50,000 shares unissued. The British Syndicate will receive £115,000 in fully-paid shares of the new Company. The North British Syndicate will receive £60,000 in fully-paid shares, which, on distribution, would yield for each £5 share now held, with £3 10s. per share paid up, quite one-and-a-half fully-paid £1 shares in the new Company; the right of the British Syndicate to participate in these shares, in respect of their holding of 23,130 shares, being conditionally waived. The Yorkshire Company will receive £25,000 in fully-paid shares of the new Company.

Meeting of the North British Water-Gas Syndicate.

An Extraordinary General Meeting of the North British Water-Gas Syndicate was held last Thursday, at Glasgow—Mr. J. REID STEWART in the chair—for the purpose of considering the following resolution:—

That the agreement submitted to this meeting, dated the 12th day of June, 1893, made between John Bodington Baker, on behalf of the British Water-Gas Syndicate, Limited, of the first part, Thomas Henry Swann, on behalf of the Yorkshire and Lancashire Water-Gas Company, Limited, of the second part, and John Henry Copeland, on behalf of the North British Water Gas Syndicate, Limited, of the third part, and Henry Thomas Glassborow, as trustee for the Amalgamated Water-Gas Companies, Limited, of the fourth part, be and is hereby ratified, and that the Directors of the North British Water-Gas Syndicate, Limited, be and are hereby authorized to concur in procuring the registration of the proposed new Company, and enter into an agreement with such new Company when incorporated in the terms of the draft-adopted contract set forth in the schedule of the said agreement of the 12th day of June, 1893, and to carry such agreement into effect, with such, if any, modification as may be expedient.

The CHAIRMAN, in moving the adoption of the resolution, said that, in connection with the proposal now made, the Directors had submitted a statement to the Lord-Advocate, accompanied by a complete set of documents, with the result that the views held by them were entirely confirmed by his opinion. A few days since a circular had been issued by Mr. Allan, the agent for the dissentient shareholders, stating that the opinion of Sir Horace Davey had been obtained, and that it coincided with that of Mr. Macaskie, Counsel for the Notts and Derby Company. The Directors, however, were convinced that, if Sir Horace Davey had had a plain narrative of the facts before him, with documentary evidence, he would have given a similar opinion to that of the Lord Advocate. Litigation would be disastrous for the shareholders, many of whom were interested in the three Companies, and therefore would be fighting against themselves. The Directors denied that there was any misrepresentation in the prospectus. They deeply regretted the barren results so far; but they believed, with unity, water gas might yet be made a success. In all they had done, the Directors had been guided solely by the interests of the shareholders. Mr. Thomas Reid and Mr. Samson Fox, two of his co-Directors, were both, unfortunately, out of the country; but had they waited their return next week, the date of the meeting would have been too late to preserve the right of voting on unpaid shares. The chief advantages of the scheme were: (1) The avoidance of protracted and costly litigation, which might cost thousands and thousands of pounds; and (2) the extinguishing of liability to the extent of 30s. per share, and an interest retained in the possible future of water gas. The Directors were sorry to learn that, without having the support of more than a small minority of the shareholders, Mr. Allan had ventured to issue a writ in the name of this Company against the North British Syndicate. This step the Directors entirely repudiated; and, in the interests of the general body of the shareholders, they had instructed their Solicitors to take the necessary measures for the protection of the Company.

Mr. J. SCOTT seconded the motion.

Mr. ALLAN proposed a counter-motion; and, in doing so, he disagreed with the statement of the Chairman that the interests of the shareholders was the same as those of the Directors; and he quoted figures to show that the Board were largely interested in the Leeds Forge Company. If water gas had been a success, the Leeds Forge would have obtained a great amount of work. He complained that the smelting results from Spencer's Newburn Works, Newcastle (which they expected to hear in December, 1891), had not been forthcoming, according to the promises given. Such was water gas after four years' trial; and, with these results, they were asked to go and join with other Companies who were also trying to work water gas. As far as he could see, these Companies were bankrupt; while their own Company had £12,000 in hand. If a trial during four years, with a free hand to the parent Company and about £400,000, would not make water gas under these patents a success, he asked if their £10,000 and a call of 10s. per share could possibly do it? The Notts and Derby Company had been successful in their refusal to pay their share, seeing that the prospectus was false from top to bottom; and he had no doubt the Glasgow shareholders would be equally successful. He declared that before the day was over, he would lodge his protest against the paying away of their money, and would, by their writ, which had been served under the best advice, call upon the Directors to aid them in recovering their money. He wanted to know where all the money had gone—the £145,000 of the North British Company and the £400,000 of all the Companies—money which had been spent on barren results. He protested, in the name of the dissentients, against the Directors paying a farthing more money over to the parent Company, and warned them that they would be held personally responsible.

Mr. WORTH, who, since April, 1891, has been a Director of the British Water-Gas Syndicate, addressed the meeting; but he had not proceeded very far before he was charged with making insinuations against the dissentient shareholders, and a stormy scene ensued. After speaking on the evidence in the Notts and Derby case, he said he could state that, if there had been any looseness, it was not on the part of the shareholders of the British Water-Gas Company. He had been speaking to some of the gentlemen connected with the Leeds Forge Company; and they told him that the saving by the use of water gas in the Leeds Forge had been £10,000 a year about 1891. He would continue to have faith in water gas until they found it a fraud.

Mr. SCOTT stated that the Leeds Forge Company fitted up five plants for water gas; and they did not make a single piece of it themselves. They never made water-gas appliances, and never would.

Mr. WORTH expressed his personal conviction that, by united effort on the part of the new Company, the patent could be brought to its expected value.

Mr. D. CAIRNEY, who seconded the amendment, remarked that he was more dissatisfied than ever, and was convinced that the thing was worthless and rotten.

Mr. W. NEILSON said he must admit that what Mr. Worth had said was correct. Only £4000 had been spent in experiment in water gas; but where had the rest of the money gone? He asked the Chairman if he was going to use water gas in his new works at Wishaw.

The CHAIRMAN replied that they were not laying down water-gas plant at present.

A vote was then taken, when 13 voted for the amendment and 9 for the motion. A poll having been demanded,

The CHAIRMAN said the Directors had an overwhelming majority.

Mr. ALLAN entered a protest against the 20,000 deferred shares held by the Chairman and Mr. Samson Fox being used in voting, as they were not on the same footing as the others.

The CHAIRMAN observed that Mr. Samson Fox was the first holder of deferred shares; and his attorney was present to vote for him.

On the respective shares being counted, the total number of votes was ascertained to be 36,635, of which 5432 were given for the amendment, and 31,203 for the motion.

The meeting then terminated.

The Proposed Litigation.

With reference to the writ (mentioned above) which has been issued on behalf of the dissentient shareholders of the North British Syndicate, we understand that they claim to have the agreement for the sale of the patent rescinded on the alleged ground that the same was procured on false representations made by the defendants and their agents to the plaintiffs, and the return of £175,000 as thereby paid by the plaintiffs to the defendants. It also craves an injunction to restrain the defendants, their Directors, and their agents from receiving from the Directors of the plaintiffs any further moneys in respect of the said agreement, and claims damages for misrepresentation.

Yorkshire and Lancashire Water-Gas Company.

A Meeting of this Company was held on Friday, for the purpose of considering the scheme of amalgamation. Mr. J. Mitchell presided, and he moved a resolution in almost the same terms as that submitted at the North British meeting. The Directors, he said, had fixed this meeting prior to the payment of 10s. per share, so that the shareholders might have an opportunity of voting on the proposal, instead of waiting until after the payment was due, in which case the dissentients would have been deprived of the power of voting. He deeply regretted the barren results so far; but there was no doubt, when the Company was a united one, water gas would have a chance it had not hitherto had. After personal experience, adopting it himself and carrying on experiments with coal shale, he was satisfied that in the future there would be very considerable benefit to the shareholders. Mr. Warren seconded the resolution. Mr. Brook expressed himself in very strong language concerning the scheme—describing it as "filthy and putrid as the River Aire." The next speaker (Mr. Whitehead) was equally vehement in his remarks. Every member of the Board, he said, knew that he could not point to a single contract in connection with the business, or to a penny of profit it had produced. What was known to-day was known when the Company was floated. They were perfectly aware of the fact that they had not a patent that was worth the paper it was written upon. He wanted to know how it was that the Leeds Forge Company repudiated their right of a claim upon them for their royalties. He concluded by moving the following amendment: "That, after four years' experience in the working of the Water-Gas Company, resulting in the loss of its capital in fruitless efforts to practically develop the use of water gas for the purpose set forth in the prospectus, with no prospect of making the undertaking a commercial success, thereby entirely falsifying the statements contained in the prospectus issued to the public—the Directors having also, contrary to their powers, and without the knowledge or consent of the shareholders, bought shares in the British Water Gas Syndicate, Limited, thereby incurring a loss exceeding £20,000—this meeting emphatically condemns any scheme of amalgamation, and refuses to sanction any expenditure with the view of further experiments in water gas, and that a Committee of Investigation be appointed for the purpose of securing the winding up of the affairs of the Company without delay." This was seconded; and afterwards Mr. Worth, the Managing-Director of the British Water-Gas Company, addressed the meeting, amid much interruption. He said he greatly regretted that the application of water gas for steel smelting at Newburn and for puddling at Glasgow had not been sofar successful; but he believed it would be. There had been some successes in this country outside the Leeds Forge—notably for welding and singeing. In addition to this, there was lighting. Gas companies were using carburetted water gas as a substitute for coal gas, or for enriching it. There was also incandescent lighting, for which there was a large field, now that much prejudice against water gas had been removed. He was informed that at Hamburg they were about to inaugurate a system of lighting with the incandescent water-gas light. One of the difficulties to be overcome—namely, the utilization of the generator gas—had been solved this month at Lancaster to the satisfaction of Mr. Bernard Dawson, acting for the Lancashire Waggon Company. Independently of the considerations he had given in favour of the scheme, there was also the fact of liability avoided. Those who did not share the belief of the Directors got a payment of 30s. per share. There was a sum roughly of £160,000 that could be called up from the three Companies; and this scheme relieved them of a total liability of £133,000. It would, indeed, be disastrous to the shareholders if this large sum of £160,000 were risked in litigation. By working altogether, he believed the shares in the new Company would become of value. A vote was taken, and 14 were in favour of the amendment and 10 against it. The Chairman announced that he held 1700 proxies in favour of the resolution; and the amendment was therefore lost. The resolution was then put and carried.

Exhibitions of Gas Appliances.—Messrs. Fletcher, Russell, and Co., Limited, have lately completed a series of three very satisfactory exhibitions of gas appliances in Edinburgh and Leith; and Messrs. Richmond and Co. have been exhibiting in Aberdeen, with the assistance of Mrs. Black as lecturer and demonstrator.

Improvements at the Conway Gas-Works.—The Conway Corporation have accepted the tender, for £1660, of Messrs. R. Dempster and Sons, Limited, of Elland, for carrying out certain alterations to buildings and furnishing additional plant at the gas-works. The new plant comprises a telescopic gasholder with concrete tank, an engine and exhauster, a new boiler, and a steam-pump.

The Barnet Gas and Water Company and their Brick-Making Contractor.—In the Queen's Bench Division of the High Court of Justice last Saturday, Mr. Justice Wright had before him a claim by the Barnet Gas and Water Company for damages, arising out of a contract for the manufacture of bricks; while the defendant (Mr. J. South) counter-claimed for loss occasioned to him by the detention of his plant. Mr. Finlay, Q.C., and Mr. Lyons appeared for the plaintiffs; Mr. Cyril Dodd, Q.C., and Mr. Lush, for the defendant. It may be remembered that the case was opened some time ago (see JOURNAL for May 23, p. 957), and was then adjourned in order that an inspection might be made by an independent expert, for which purpose Mr. Wood was appointed, with the consent of both parties. His report having been made, his Lordship gave judgment for the plaintiffs for £100, less £30 retained under the terms of the contract; and for the defendant, on the counter-claim, for 1s. without costs.

THE ELECTROLYSIS OF GAS AND WATER PIPES.

In previous issues of the JOURNAL, reference has been made to the appointment of a Joint Committee of the two Houses of Parliament to consider the question of the advisability of inserting, in connection with the granting of statutory powers for the supply of electricity, protective clauses bearing upon earth return-currents, &c.; and last week we stated that, in view of possible injury to gas and water pipes by electrolytic action, the Gas and Water Companies were to be represented. The Committee was constituted as follows: Viscount Cross (Chairman), Earl Russell, the Earl of Rosse, Lord Clifford of Chudleigh, Lord Ker, Mr. Brunner, Major Darwin, Mr. Forwood, Mr. Molloy, and Sir Bernhard Samuelson. A strong array of Counsel—including Mr. Pope, Q.C., Mr. Fletcher Moulton, Q.C., Mr. C. A. Cripps, Q.C., Mr. Balfour Browne, Q.C., and Mr. Worsley Taylor, Q.C.—was in attendance on behalf of the various bodies whose interests were affected. The sittings commenced on the 19th ult., and were continued till the following Friday, when the inquiry was adjourned until the 26th ult. On the resumption of the proceedings on that day, the above-mentioned matter was specially considered; and the following is an abstract report of this portion of the investigation.

Major *Cardew*, R.E., Electric Adviser to the Board of Trade, was called by the Committee as an independent witness. He stated that he had examined into various cases of accidents to gas and water pipes, and specially referred to those at Preston at the commencement of the present year, which had been attributed to electrolytic action, but which he held to have been the result of heat caused by the passage of the electric current between the iron culvert in which the electric light mains were contained and the gas service-pipes which were injured. By the courtesy of the Preston Gas Company, he was able to produce specimens of the pipes which were cut out immediately after the accident. That which was the result of the accident in Wheatley Square on the 27th of January last had a hole eaten out of it where it was in contact with the culvert, and on the 25th of January the lead service-pipe in the square was melted. He attributed this to an electric arc set up in the first place by imperfect contact between the culvert and the gas service-pipe; and as the latter melted away the arc was established, which caused the amount of fusion that occurred. This was due to the imperfect state of the works of the Electric Light Company. One side of the circuit had a temporary connection with earth accidentally formed, and the other was accidentally brought into connection with the iron circuit enclosing the main. On the 24th of February a service-pipe going into a stationer's shop in Fishergate had 3 inches of it melted, where it came in contact with the electric light culvert. These accidents were not due to electrolytic action, but to something much more rapid—viz., heat produced by a current of electricity passing through them. The dry and sandy soil in Preston had, in his opinion, something to do with these accidents. The heat was produced by faulty insulation of the mains inside the culvert. He did not think it impossible, by protective clauses, to prevent accidents happening, although he considered the risk might be very greatly diminished by precautions and attention to regulations. A long line of culvert containing bare conductors being allowed to come so near the unprotected gas-pipes was an error of judgment, and was probably due to the hurried way in which the installation was carried out. He was afraid it happened in many cases that electric light installations were carried out in a great hurry; and, as the result, things were overlooked, and accidents happened. A connection was made, owing to defective arrangements in switching, in some lamps for public lighting; the lamp-posts having previously been used for the supply of gas. His attention had been drawn to several other cases of damage to water and gas pipes; and, by means of tests which he had carried out, he was enabled to prove that damage was caused by electrolytic action. He produced one of the pipes, which was very much corroded throughout; but he thought it better not to mention the name of the town in which the damage occurred. The difference of potential which he found on testing between the electric culvert, which was of the same character as the one in Preston, was 6 volts, which was quite enough to account for considerable electrolytic action. The pipe was full of water at the time; and the same current which was flowing through it, and causing corrosion on the positive side, must also have been causing corrosion on the negative side. He suggested, as a means of preventing electrolytic action, that the negative terminal of the dynamo should be connected by the water-mains, which would have the effect of causing any leakage crossing between the electric system and the water-pipes to corrode the rails of the tramway, and preserve the water-pipe. This system had, on his suggestion, been tried in connection with the Leeds tramway; and, on opening the road some time after it had been set in operation, no sign of injury to the gas or water pipes could be discovered. In the case of electrolytic action to which he had referred, he found, when he tested it, that there was a steady difference of potential of 6 volts. The pipe had had to be changed at intervals of about six weeks for several months in succession; and during the time there had been an earth fault on the mains of the Company, of which they did not know. While this earth fault was on, there were continual failures of the gas-pipe. The damage was confined to one section of the pipe; and the electrolytic action occurred only at the point where there was an accidental contact made with the earth. This was certainly preventible; and the imperfect means of localizing and testing was the cause of the fault remaining so long. He had no doubt such a fault would not be left any length of time now, since attention had been drawn to the matter. In the case of a tramway working with uninsulated returns, precaution should be taken that the leakage did not hurt other people. They could not prevent its hurting something; but by the means he had suggested, it might be confined to their own rails. Having regard to his experience, he should say that the Leeds system might, with proper precautions, and proper watchfulness and testing (which was a most important point) be carried on without any damage to gas and water mains. Two volts was about the amount of electro-motive force needed to produce electrolytic action. He did not see the necessity for any regulations to secure the immunity of gas and water pipes from this action; but, assuming that regulations were drawn up, no danger need be apprehended.

Sir *F. Bramwell*, F.R.S., was then examined by Mr. POPE on behalf of the Gas and Water Companies. He said he had given attention to the subject of electrolytic action, which he regarded as dangerous. In the case of electric lighting, it could only be produced by accident; but in the case of tramways, like the one at Leeds, with uninsulated returns, it was a constant and real danger. Major Cardew's proposition to connect the negative pole of the dynamo to the water-pipes did not, it seemed to him, take account of the fact that they must have continuous water-pipes. The pipes might stop, and they would have the gas-pipes left unprotected. The water-pipes, too, had joints which were absolutely impermeable by electricity. It must also be borne in mind that most water-pipes were coated with Dr. Angus Smith's composition—a black varnish, which was not a good conductor of electricity. This was not a new subject to him, for it came before him in the case of *Lane-Fox v. The Kensington Electric Lighting Company*. In that case the suggestion was made of using the water-pipes as a return (they being included in the term "earth"); and the question of electrolytic action was consequently raised. The conclusion at which he arrived was that it was dangerous, and ought not to be allowed. He should wish to have much more experience of Major Cardew's plan, as to its effect on gas and water pipes, before he could assent to the proposition that it would remove all cause of anxiety. In his judgment, the only method of securing safety against electrolytic action was the proper insulation of both the outgoing and incoming conductor from the earth, so that there should be no leakage whatever except in time of accidents; and in that case it would be very different from the harm being done by interference with the telephones. The waste of a pipe by electrolytic action was due to the amount of current and the time during which it acted. Supposing there were a failure, from some accident, of perfect insulation, and electrolytic action were set up, it might go on perhaps for one day in the year, or for a week in the year; and the harm done would be in proportion to the time it went on. In the case of the telephones, the annoyance was immediate; in that of a gas company, it was dependent on the time and quantity. Therefore any system which prevented heat, and which had any imperfection, would still be defective. He did not regard a provision for the prevention of such action as being prohibitory to electric traction. He could not imagine that the Legislature would ever allow the streets of London to be worked by means of overhead lines. If they did not, there was no other method, except working by accumulators, which was perfectly feasible and innocuous, or by conveying the electricity in tubes underground. With the latter plan, there was no difficulty in having both the incoming and outgoing main in the tubes.

By Mr. WORSLEY TAYLOR: When he spoke of the Leeds system as being a real danger, he had in fact, found none; but one thing to be considered was that the harm was covered up. It might go on, and nobody know anything about it until the rupture took place.

By Lord KELVIN: In the case of electrolytic action upon water-pipes, there was not much risk to life; but in the case of gas-pipes being ruptured when the road was covered over with concrete, they knew nothing about it until the gas came into the area of the house and into the kitchen. Then the kitchen fire got hold of it, and the result was a serious explosion.

Dr. *J. Hopkinson* was then called. He stated that he had long held the opinion that there was a probability of a certain amount of oxidation to the gas and water pipes from the currents meeting and passing through them; but it was only comparatively recently that he had realized how very serious the disturbance might be. His view was that the only thing that could be done to prevent oxidation was to insulate the whole system of electrical conductors as used for tramways. If they had this system, they could arrange testing apparatus of a very simple kind, which would tell at once if a conductor had contact at any point with the earth. To show of what a serious character the danger to gas-pipes was, he produced a gas-meter with two holes eaten into it by the action of electricity. Paint would act very slightly as a non-conductor. But in some places paint was liable to be scratched off; and then, of course, it was of no use. There had been many cases of serious explosions occurring in the streets from undetected leaks from gas-pipes. The worst thing that could happen would be that there should be actual metallic connection between the earth and the pipe. If the gas-pipe as well as the water-pipe were connected with the negative pole of the dynamo machine, they might have, at some point of the gas-pipe, want of electrical continuity, and they might have a current leaving the pipe at one point, and returning to it at another; and there they would have oxidation. Gas-pipes were more or less moist, as the companies did not trouble themselves much whether the soil in which they laid their pipes was moist or dry. He did not think there was any difficulty in insulating both conductors. Between the two flanges of the joint of a pipe was a piece of millboard, which was an insulator if dry, but if wet it connected electrolytically. With an ordinary spigot joint, he believed this would not occur. If a joint became a little loose, rust would occur. Culverts with slots in them were not, he thought, found to interfere with traffic in any way. The accident to the gas-meter occurred in an insulated system; but it was allowed to exist for many months, when it ought to have been put an end to at once.

Earl RUSSELL: You would not agree with Sir F. Bramwell that the black varnish on the outside of the pipes would prevent them conducting to the soil?

Witness: No, it is not enough. There is a large area of metal covered, and the varnish is very thin. With regard to flanges, he was not aware of cases occurring where flange pipes had been injured.

Professor *Dewar*, F.R.S., was the next witness. He stated that his attention had been directed for some years past, purely from the chemical side, to the question of electrolytic action upon gas and water pipes. He was aware that damage had occurred from this cause in America; and he mentioned a case of electrolysis on water-pipes, the details of which had been given in the *Electrician*.

Mr. POPE: It is a danger present to the mind of those interested in electrical service, not only here but the other side of the water also?

Witness: That is quite clear.

What do you say is the remedy for the danger?—The only condition is the one suggested by Sir F. Bramwell and Dr. Hopkinson. That is, of course, the removal of the possibility of electrolytic action on the one hand, and the prediction that was foreshadowed by a witness on behalf of the Government this morning—Major Cardew—that something might be done by connecting the water-mains with the negative pole. I ought to say that this suggestion was dismissed in America as impracticable.

Would you rely, as a practical measure, on this connection of the negative pole with the water-main?—No; I would not. My serious difficulty is, of course, the chemical extent of the corrosion of iron pipes in the subsoil. In our time, many chemists have devoted their attention to this, both at home and abroad. But the problem is an exceedingly complex one; it varies with the character of the iron. Then where there is a large amount of drainage, the subsoil is stored with carbonic acid and ammonia, with nitrates; and these are conditions under which the pipes are oxidized. The principle of keeping a large metallic system practically connected with a negative pole would mean to transform it into a condition of the metal which would not be attackable, owing to an infinitesimal layer of hydrogen. But, unfortunately, the condition of the chemical fluid in these pipes is exceedingly favourable to the removal of this minute layer of hydrogen.

So that the corrosive action takes place, although a remedy may temporarily be made available?—That is what I say. There is no guarantee that it will be uniform over the large metallic area of the pipes. There is no real remedy but absolute insulation.

Mr. BRUNNER: Are there any instruments for testing insulation?

Witness: It is exceedingly difficult to localize leakage. The completeness of the insulation could, no doubt, be ascertained; but on a gigantic system, such as an electric tramway, there must be a large loss. Variations in insulation will doubtless be recorded; but where to find the defect is another thing. My difficulty as a chemist is this—that, while you might save the equivalent electrolytic attack on the iron for so many points, this does not prevent the natural and corrosive attack being greatly accelerated by the indirect effect of the passage of the current. It is not only the equivalent of the current doing damage to the pipe by oxidization. The question is what is the effect of this upon the ordinary rapidity of corrosion which takes place in the subsoil. I think it will be accelerated in the majority of cases. Everything is done to protect water-pipes; and nothing has been so successful as Dr. Angus Smith's coating of tar, or rather pitch. But this has not the same co-efficient of expansion as iron; and it cracks and comes off.

Mr. *G. F. L. Foulger*, Chief Distributing Engineer of The Gaslight and Coke Company, was the next witness. He stated that he had already had great difficulty in coping with escapes under the London streets that were concreted. The escape of gas sometimes percolated through the earth from the place of leakage a considerable distance. There was another danger, which had recently been illustrated in Oxford Street. The concrete on which the pavement was laid formed almost a perfect arch; and the loose friable earth with which London roads were constructed was continually sinking. The consequence was that large cavities were left between the concrete and the earth. He viewed with serious apprehension the danger to the gas-pipes. The water and the gas mains were of necessity very close together. The total loss of gas in transit amounted to 4 per cent.; but less than 1 per cent. was owing to leakage—the chief part being due to the difference in temperature at which the gas was registered at the works and in private houses. His experience was that a cast-iron pipe put in a suitable soil was practically indestructible. He had seen pipes which had been underground for fifty years, and were as sound as a bell.

After some further evidence, the Committee adjourned.

On the following day, Counsel addressed the Committee on behalf of the several interests concerned.

Mr. MOULTON, in speaking for the railway companies, and claiming that they should be protected against earth currents, urged that it would not be much more expensive for the electric tramways to adopt the insulated return system. When they were talking of what the cost of electric traction would be, they had no business to estimate it by a method which would throw an expenditure on their neighbours. Supposing a system were adopted which destroyed the gas and water pipes, no doubt this would cost the companies owning them a large sum; and, in estimating the cost of this method of traction, they had no right to look only into the books of the electric traction company, but they should also inspect those of the gas and water companies, and see what they had had to pay towards it. The sum of the two was the true cost of this method of traction. If electrical currents were going about, everyone was in danger who had any extensive continuous metallic structure. The railway companies owned largely water and gas pipes. He understood that Major Cardew proposed to protect metallic water-pipes from the current by connecting them with the negative pole of the dynamo. But the Major did not seem to have the courage of his opinions, as he did not recommend that the same method should be applied to the gas-pipes. Gas-pipes were equally continuous, equally widespread, and were as certain to have electricity conducted by them, as water-pipes. On account of the obvious difficulties, he dared not face connecting the gas-pipes; and he deliberately left these pipes, which were only specimens of a long connection of a metallic structure, exposed to electrolysis. The railways had their pipes all over their stations; and they would have the same sort of thing that went on, in the case of electric currents under the ground going on from gas-pipe to water-pipe. Nobody denied that, under these circumstances, there would be corrosion. There had been a certain amount of confusion between the two ways in which corrosion could arise. It might arise when the current went into a water-pipe; but they could stop this by causing it to go in the negative direction. But there was corrosion caused by running along their conductors. When they came to a place which was not a perfect conductor, the current left, and went back again; and at one of these points there must positively be corrosion. That was only aggravated by joining the water-pipes to the negative pole of the dynamo, because they forced it to be the return conductor; and at every place where there was a cessation of conductivity, to a certainty there they would have corrosion. No one had ventured to deny this. Those who said that such currents could go about without effecting corrosion, were themselves afraid to protect the gas-pipes; and the non-protection of these pipes destroyed all the value of the supposed protection of the water-pipes, because it made each the enemy of the other.

Mr. CRIPPS then addressed the Committee on behalf of the traction companies. He submitted the following clause: "The company shall use metallic returns, and, in working their system, shall take such reasonable precautions as the Board of Trade may direct for preventing interference with any properly-constructed insulated metallic circuit of any railway or telephone company, and for preventing electrolytic action on gas and water pipes."

Mr. POPE followed on behalf of the gas and water companies. He said it was almost amusing to see the way in which Mr. Cripps, representing the traction companies, frankly confessed that it would suit him better to have no clause at all, and then proposed a clause which would effectually carry this out, because it would relegate for the Committee that which he supposed was the duty they had assumed, and send it back again to the Board of Trade, who had asked the Committee to consider it. When Sir Courtenay Boyle was giving evidence, he (Mr. Pope) thought what he stated was that the Board of Trade had found so much difficulty in framing their Provisional Orders, and in deciding upon the restrictions which should be inserted there, that they had intimated the appointment of the Committee in order that this difficulty might be solved by them and not be relegated to the Board. Mr. Cripps proposed that "the company shall use metallic returns." This amounted to saying that they should do only what they were now doing, because it had been proved that they did use metallic returns, and must do so, as they could not otherwise obtain the return of the current they were adopting. He did not say "insulated metallic returns," but simply "metallic returns." In other words, the clause might be paraphrazed thus: "That this Committee recommends that the traction company do what they are doing, and that the question of what restriction is to be imposed upon them shall be referred back to the Board of Trade." This really was what the clause amounted to; and he could not help thinking that it was rather an ingenious method of tempting the Committee to give no clause at all, because practically, of course, it would be an abrogation of the duty the Committee had taken upon themselves. He proposed, on behalf of those he represented, to ask definitely that the Committee should recommend that, in all future grants of statutory powers to use electricity, insulated metallic returns should be required as a condition of that user. The actual phraseology of the clauses that he would suggest was taken from the restrictions already imposed in the Electric Lighting Acts, and in other Acts of Parliament relating to this matter. The question which really arose now was whether any grant of power to use electricity as a means of traction, would operate unfairly and injuriously towards the expansion of such an industry. He was not sure that they had not from the commencement of the inquiry dealt with it as though it were a question between two parties, who were constituted private enterprises, as to their respective interests in the use of electricity. He was not very much concerned whether they thought the National Telephone Company should be driven, not by legislation (because this was not within the scope of the reference to the Committee), but by the necessity of the case, to complete their system by instituting metallic returns; and, excepting on the general principle that it seemed hard that a railway company, using its own property in a harmless way, should be compelled to incur expenditure in order to protect themselves against somebody using the same common property in a way to do it injury, he was not specially concerned with the railway case. But that of the gas and water companies—(not any particular company, but companies spread all over the country, wherever electric traction was contemplated at all), had this particularity about it—that, at all events, the companies could not protect themselves. If there were a danger to which they were subjected, they could not be answered by saying: "If you will complete your circuit you can protect yourselves." The danger apprehended by the gas and water companies from electrolytic action was one against which they could not protect themselves; and, according to the evidence to which he would call the attention of the Committee, in the opinion of some very eminent scientists, it could only be effectually guarded against by the use of the insulated metallic return by the tramway companies. He would prefer not to deal with this matter as a question of private enterprise, as it was rather an all-round one. It was a question of whether, in the general interests of the community, there ought to be such restrictions put upon the use of electricity for traction as would secure the safety of the public in the sense of the safety of all industries in which the public had an interest. Now, the gas and water companies were not merely private enterprises. Assuming for a moment that there was a real danger, that the use of metallic circuits—if they pleased, uninsulated metallic circuits—with the leakage which was necessarily consequent from the system, might cause corrosion of gas or water pipes, this created additional risk of explosion, of floods, and of other troubles which were public inconveniences. In the case of a gas explosion, it was not merely the interest of the company involved, but that of the public at large. Looking at it in this light, he confessed that a great many of the observations which had been addressed to the Committee appeared to him to be somewhat irrelevant. Mr. Balfour Browne seemed to think that, because there was the possibility, in a great many cases, that tramways, as well as gas and water companies, might become common property, there was no need for such protection. It could not matter, in the case of a gas explosion, whether the gas that caused it was the property of a corporation or of a company; and electrolytic action, if it did take place, would no more respect the pipe of a corporation than one of a company. So that the whole question was whether they were entitled, on the part of the public interested in this question of gas and water supply, to ask for absolute security against the risk they feared. That there was a real risk, he thought was admitted

on all hands. He would point out what appeared to be even a more serious question than the specific action of the electric current in the nature of electrolytic action. But were they entitled to ask for absolute security? Absolute security could only be obtained by enacting that the return current should be an insulated metallic circuit. Did not this depend upon what was the nature and character of the risk? Was there anybody with sufficient experience now to be able to accurately define what the nature of the risk was? He would not attach the least value to evidence given either at Blackpool or elsewhere, that certain pipes dug up had not shown signs of electrolytic action. What they wanted was experience; and there was no experience of tramways in this country which could justify them in forming any opinion at all. But when they looked across the water, where electric traction had been more largely employed than here, they found that now, at all events, one of the burning questions connected with the whole use of such a system of traction was this electrolytic action; and they found, in the papers referred to by Professor Dewar, and placed before the Committee, statements which, if not strictly legal evidence, at any rate went to show that in America there had been found to be a real danger which had to be provided against. In fact, at this moment they were uncertain whether it was possible to provide against it completely without absolute insulation. He therefore ventured to suggest that, unless there was some very grave reason why absolute security should not be given—at all events, so far as anything under human management could be absolute—subject, of course, to unavoidable accidents which might occur in any system, they were entitled to ask for it. What was the danger in question? It was the corrosion of the gas and water pipes—corrosion which did not take place instantaneously, and could not be detected by any test, but which, going on, was a hidden source of danger that ought to be provided against. He pointed out that Professor Dewar's evidence, which seemed to be deserving of grave consideration, was this—that it was not merely a question of specific electrolytic action, due to an escape from the currents, or the action of electricity on the pipe itself, but was a much graver question. It was how far this additional cause of corrosion, added to natural causes, which, though not of an electrical character, still undoubtedly contributed to the destruction of the life of a pipe, was a preventible danger. Professor Dewar said that the possibility of keeping a large metallic system practically connected with the negative pole would mean transferring it into the condition of a metal that would not be attackable owing to the infinitesimal layer of hydrogen. But, unfortunately, the condition of the chemical fluid that was bathing these pipes in the subsoil, was highly favourable to the removal of this minute layer of hydrogen; and consequently, the nitrates were reduced, and the thin layer of hydrogen was thereby removed. The corrosive action took place, although the remedy might temporarily have been made available. So that it was not merely a question of protection against the specific action of the current, but it was the contributive corrosive action which that current might be supposed to exercise, in addition to the natural causes which otherwise would destroy the pipe. He did not think there was any evidence upon which the mischief that might arise could be accurately diagnozed. But if it was true, as Professor Dewar said, that there was a constant contribution of corrosive action which was to be apprehended—nobody being able to define the extent of it—and which could not be completely got rid of even by the suggestions made by the Board of Trade in the case of Blackpool, were they prepared, for the sake of any advantage which could be gained by the electric traction which was before them, to run the great public risk which such a danger must necessarily involve? He owned he had not himself seen any reason why this risk should be run. It was one against which they could not protect themselves. His proposal was: "The undertakers"—the tramways—"shall not make use of, or permit to be used, any conductor other than an effectively insulated conductor for carrying any supply of electricity from or to the generating station, nor shall they in any manner connect, or permit to be connected, to earth any part of any circuit, except for the purpose of testing or indicating." That was to say, put the traction companies under the same restriction as the electric lighting companies. This, he thought, was *verbatim* the restriction under which the electric lighting companies, who used a current very much of the same character, and with the same effect, were actually placed by the Provisional Orders which had been sanctioned by Parliament. What was the answer to that? Only that, if they did this, they would prevent the extension of electrical traction in this country. If he followed Mr. Cripps's argument, it was this: That, in order to obtain an insulated earth return, they must incur a cost which would be prohibitory to tramway extension. According to the evidence of Sir F. Bramwell and other witnesses, as to what the additional cost as compared with the overhead system would be, it practically came to this—that what was really asked was that that which should be encouraged was the overhead system. If this were not adopted by the local authorities, of course, traction then could only be possible by conveying the current or cable underground; and if it was conveyed underground, a culvert was necessary. The culvert was the source of expense complained of. But it would be just as easy to carry two cables in a culvert as one, according to Sir F. Bramwell; and the space required was not larger than was needed for the purpose of cable tramways which were being worked successfully in this country. The cost of the culvert, therefore, was not a prohibitory one; and this was practically the only additional expense that would be cast upon the tramway companies if they adopted the insulated metallic return. Was it worth while, then, to run the risk which Sir F. Bramwell, Dr. Hopkinson, and Professor Dewar had indicated to the Committee—an unknown risk, he admitted, but one which ought to be foreseen, if this could be done. Was it worth while to do this for the purpose of securing the possibility of the adoption of the overhead system of tramways? He knew that, in dealing with the Buda Pesth question, Mr. Siemens pointed out that at Bradford he found it impossible—not electrically impossible, but simply impossible—because the culvert which would be required would be so inconvenienced by adjoining pipes and other matters underground, that he could not make it. But was this any reason why they were to have the overhead system in every city—because the streets of the large towns were so occupied as to make a large culvert impossible? This did not apply to the cases, for instance, of Blackpool and Leeds. In the Blackpool case, the cable was conveyed in a culvert, and there would be no more difficulty in conveying a second one in any other culvert of the kind. The question seemed to him to be a comparatively simple one. The case of the gas and water companies must, of necessity, be presented to the Committee somewhat hurriedly and imperfectly, because it was true that, in the inception of the Committee, the companies had no notion of what was intended or what was at stake; and it was only when attention was directed to Mr. Preece's evidence that they became alive to what the danger and risk really were. The question, therefore, which, with great respect, he would leave to the Committee was whether this risk ought to be run when it could be provided against by those who caused it, and could not be provided against by those who had to undergo it. The clauses he suggested, as absolutely necessary to protect the gas and water pipes from risk were these:

(A) The undertakers shall not make use of, or permit to be used, any conductor other than an effectively insulated conductor, for carrying any supply of electricity from or to the generating station, nor shall they in any manner connect, or permit to be connected, to earth any part of any circuit, except for the purpose of testing or indicating.

(B) The undertakers shall employ all practicable means for preventing, detecting, and as soon as practicable stopping, any leakage of the electric current to earth.

(C) The undertakers shall not use or employ, or permit to be employed, any gas or water mains or pipes as conductors for the purpose of completing any electric circuit, or for the conveyance of electric current.

(D) Nothing in this Order contained shall prevent the undertakers from being liable to an indictment for nuisance, or to any other legal proceeding to which they may be liable, in consequence of generating, using, or supplying electric currents.

The last was the provision which occurred in the Orders made in the Electric Lighting Acts. There then followed the reservation of an indictment for nuisance, which was similar to that which was contained in the Gas-Works Clauses Act, 1847, and which also subsisted in the Electric Lighting Acts.

(E) The undertakers shall compensate every person who suffers any damage by reason of any failure to observe the provisions of this Order, or caused without any default on his part, or on the part of persons for whom he is responsible, by an electric current generated, transmitted, or employed by the undertakers.

Mr. WALLACE made an application to be heard on behalf of the electric lighting companies.

The CHAIRMAN said that if, after discussion of the matter, the Committee considered it necessary, they would give Mr. Wallace an opportunity of being heard.

The proceedings then concluded.

MANCHESTER CORPORATION GAS AND ELECTRICITY SUPPLY.

Annual Report.

The report of the Gas Committee of the Manchester Corporation for the year ended March 31 last will be presented to the Council at their meeting to-morrow. The report states that the quantity of coal and cannel carbonized was 365,235 tons, being 14,044 tons, or 4 per cent., increase, as compared with the previous year. In addition, there have been used 40,000 gallons of carburine for enriching purposes. The percentage of cannel used was 51·76, as against 59·72 in the preceding year. The permanent results of the use of carburine have not yet been fully ascertained; but they have been so far satisfactory as to encourage its use for a further period. The quantity of gas made was 3,636,680,000 cubic feet—a production of 9957 cubic feet per ton; being 273 cubic feet in excess of last year. The total quantity of gas accounted for was 3,503,960,000 cubic feet; leaving 130,730,000 cubic feet, or 3·6 per cent., as loss by condensation and leakage, as against 4·7 per cent. in 1891–2. The increase in the quantity of gas transmitted from the works was 6·76 per cent. The average illuminating power was 19·11 candles. The number of consumers in the city was 65,958, and beyond the city 15,475; making a total of 81,433, or an increase of 862. The average consumption of gas per consumer in the city was 42,482 cubic feet; and beyond the city, 26,604 cubic feet. The number of gas fires and cookers in use was 5302, and of gas-engines 716, as compared with 4842 and 591 respectively for the year ended March, 1892. The quantity of gas used in these appliances is estimated at 143,000,000 cubic feet; being an increase of 14·4 per cent. There were 209 prepayment meters of several types in use at the end of the year, through which was consumed about 1,235,150 cubic feet of gas. These meters, the Committee state, have not yet proved quite satisfactory, because of the frequent discrepancies between payments made and gas registered, as well as minor defects in the working of the apparatus. As defects arise, however, the makers apply remedies and make improvements which, it is hoped, will overcome difficulties and result in the adoption of a satisfactory and reliable prepayment meter. The total amount of revenue was £555,564, compared with £536,147 in 1891-2; being an increase of £19,417, or 3·62 per cent. The amounts received for gas and meter rents, stove hire, and residual products respectively are as follows: Gas-rental within the city, £361,321; gas-rental beyond the city, £69,196; city fund for street lighting, £42,828; coke, £37,408; tar, £2122; ammoniacal liquor, £23,375. The gross profit on the year's working was £104,666. After paying £25,919 interest and £13,954 sinking fund, the net profit amounts to £64,793, out of which the Committee have paid £46,046 to the city fund in reduction of rates, and placed the balance of £18,747 to the contingent and renewals fund account. The whole of the works and plant have been kept in a state of thorough repair, out of revenue. No. 1 retort-house at Bradford Road has been put into complete working order, with the necessary purifying, washing, and scrubbing plant required to deal with the increased make of gas. Three holders at Gaythorn have been thoroughly overhauled and repaired, and have had a third lift added, increasing their capacity by 720,000 cubic feet. The full manufacturing power of the works at the end of the year was 21,250,000 cubic feet per 24 hours; and the storeage capacity,

16,500,000 cubic feet. The new holder at Gaythorn, to contain 1,500,000 cubic feet, and the one at Droylsden, to contain 600,000 cubic feet, are rapidly approaching completion; and this additional storeage will be available during the ensuing winter. The Committee, as previously reported, are about to erect a large gasholder at the Bradford Road works, to contain 7,000,000 cubic feet of gas.

A report concerning the Electric Lighting Department has also been prepared. The buildings at the electric lighting station for the accommodation of the machinery are now completed; and the following plant has been fixed in position: Six steel boilers, steel tank, coaling stage and crane, steam-pipes, six 90-horse power compound vertical engines, two 360-horse power compound vertical engines, six dynamos (102 volts), two dynamos (410 volts), and two travelling-cranes. With regard to the main conductors in the streets, 1 mile 100 yards of concrete culvert have been constructed; and about 65 tons of copper strip placed therein upon porcelain insulators. Two and a half miles of cast-iron pipes have been laid, into which six miles of ½-inch and five miles of ¼-inch insulated cable have been drawn. The works are rapidly approaching completion; and it is anticipated that current will be ready for consumers by Aug. 1 next. An abstract of accounts attached to the report shows that the amount sanctioned for the purposes of the Electric Lighting Order was £80,000; and that of this sum £50,200 has been borrowed—leaving £29,800 sanctioned but not borrowed. The total expenditure to March 31 last has been £41,720; leaving to balance of capital account £8479.

DUNDEE GAS COMMISSION.

The Annual Accounts—Large Reduction in the Price of Gas.

The first paragraph of our Scotch Correspondent's "Notes" last week was devoted to a comment on the accounts of the Gas Commission of the Corporation of Dundee for the year ending the 30th of April last, which were presented at the meeting of the Commission on the previous Wednesday by the Convener of the Finance Committee (Mr. J. Mitchell). In doing so, he made an interesting statement, the principal portions of which we give below. He said the debit balance of £4780 with which they commenced the year had been wiped out; and they closed with a credit balance of £253. In view of the introduction of the electric light, and also of the depressed condition of the trade of the town, it was not reckoned advisable to look for any great increase in the consumption of gas. But in this they had been agreeably surprised; for they found that the quantity of gas sold was 454,833,350 cubic feet, as against an estimated quantity of 448,900,000 cubic feet, or an increase of 5,733,350 cubic feet. The quantity of gas used at the works remained much the same as before—viz., 5,600,000 cubic feet. But a marked decrease had taken place in the quantity of what all gas engineers had to reckon upon and contend against—viz., gas unaccounted for from escapes and other causes. This year only 42,647,350 cubic feet appeared in the accounts, as against 50,500,000 cubic feet put down in the estimate, which was the same as in the preceding year. This saving of more than 7,000,000 cubic feet of gas represented a considerable amount of money, and was 1·5 per cent. of their make. This decrease in the quantity of unaccounted-for gas was very creditable to Mr. M'Crae and those under him; for to their vigilance and care it was largely due. The total quantity of gas sent from the works during the past financial year was, therefore, 502,954,600 cubic feet, as against an estimated quantity of 505,000,000 cubic feet; and, but for the fact that they had one day less in February of the present year than in the preceding February, the quantity would have been within a few feet of the estimate. In order to produce the estimated quantity of gas, they reckoned upon having to carbonize 50,500 tons of coal; each ton giving, on an average, 10,000 cubic feet of gas. But the actual quantity of coal used was only 50,223 tons, which yielded 10,021 cubic feet per ton. In contracting for their supply of coal last year, it was thought advisable, in view of the declining tendency of the market, not to purchase all they required at once, but only a supply for seven or eight months, in the hope that the supply for the remaining four or five months would be procured at a lower price. The wisdom of this course of action was amply justified by the fact that the latter purchases were made at about 2s. per ton below the price paid at the beginning of the year. The amount paid for coal was £38,605 15s. 2d., or, on an average, 15s. 4½d. per ton; and with firemen's wages added, and the amount paid for breaking, haulage, &c., the figure was 19s. 1¾d., or a total of £48,080 3s. 4d. This was £5564 less than was paid for their supply of coals the preceding year, and £1578 3s. 4d. below the estimated amount. Their total estimated expenditure for the year was put down (in round numbers) at £93,029; while the actual amount expended was £92,010, or £1019 under the estimate. The revenue account was made up as follows: Gas sold and meter-rents, £84,346, as against an estimated sum of £83,353, an increase from this source of £993; chemical products, £6338, against £7500 estimated—a decrease of £1162 (consequent on the almost unprecedentedly low prices ruling during the greater part of the year for sulphate of ammonia and naphtha). From coke they only obtained the sum of £1228, instead of £2000, which they reckoned upon, or a decrease of £773. Owing to the competition from other sources in the sale of this article, a reduction in price had to be made during the year, and hence the reduced revenue. Their total income from all sources had therefore been £92,263, against £93,299, or a decrease of £1031 from the estimated amount. The result, therefore, of the year's working had been: Revenue, £92,263; expenditure, £92,010, or a balance to the good of £253. Following out strictly the policy of last year, they had been very careful not to debit capital account with anything except for needful extensions; the small sum of £1322 only being charged this year. In view of the large sum of upwards of £8000 being added to the sinking fund every year, a steady and considerable decrease of their indebtedness might be safely reckoned upon if those who came after them in the management of the Commission followed out the policy which they thought it desirable to adopt. As to the electric lighting department, their borrowing powers amounted to £30,000, of which they had spent £22,794; but to this would fall to be added fully £2000 still due to contractors and others in connection with the works. Up to the 30th of April, there was no revenue collected for the supply of electricity; so that no balance-sheet in connection with this department could as yet be submitted. In framing the estimates for the current year, they had not reckoned on any increased consumption of gas, although at the same time he would not be at all surprised if such were the case, as the price at which the gas was to be charged, being the lowest on record, would in all likelihood lead to an increased consumption. The quantity of gas to be provided had been put down at 500,000,000 cubic feet; and for this they had contracted for 50,000 tons of coal, which they reckoned would yield 10,000 cubic feet of gas per ton. He was very pleased to state that the condition of the coal market was such that they had been able to purchase their year's supply at prices all round cheaper than ever was done in the history of the Commission. They had, as the saying was, "broken the record;" the average price per ton being only 12s. 2¾d., or 3s. 1¾d. per ton less than the price of last year's supply. In the selection of the coal to be used, the greatest care had been taken. Every coal had been bought on its merits, after being carefully and repeatedly analyzed and tested at their works by their Engineer and Analysts. They had found that the analyses generally supplied to them by the coalowners were not reliable guides to the value of the coal offered by them. He thought he was safe in saying that such analyses were often those of picked samples, and only gave an ideal value, which was very seldom borne out, and fell short when compared with actual working results. This discrepancy often led to unpleasantness between buyer and seller; and they now placed no reliance upon any outside analyses, as their own showed the results which might fairly be reckoned upon, and which they expected to get in every-day working. The great diminution in the price of coal had therefore placed them in the happy position of being able to make a very substantial reduction in the price of gas for the current year. In this also they had "broken the record;" no less a sum than 5d. per 1000 cubic feet being the contemplated reduction. They estimated their total expenditure at £81,146, and their revenue at £82,246, which would leave a surplus of £1100. The accounts were adopted; and a reduction in price from 3s. 9d. to 3s. 4d. per 1000 cubic feet was agreed to. This is the lowest price ever charged for gas in Dundee.

PROPOSED EXTENSION OF THE BRADFORD ELECTRICITY SUPPLY WORKS.

The Gas and Electricity Supply Committee of the Bradford Corporation are contemplating the extension of their electricity supply works; but, before deciding on the steps they will take, they asked their Consulting Engineer (Mr. J. N. Shoolbred) and the Manager of the works (Mr. S. Baynes) to report as to the best means of increasing the supply. Mr. Shoolbred advocates using what is known as the "five-wire and three-wire" system in the mains, by which means a pressure at the works of upwards of 500 volts could be so dealt with as to become one of only 115 volts (the present pressure) at the delivery end of the feeding-mains. He submits that, by placing small regulating dynamos in sets of four where needed in the five-wire arrangement, it will be possible to counteract the effect of any irregularity in the demand, in different parts of the district. An increase of generating plant is recommended, by which the total output could be brought up to 6000 ampères. The cost of the new distributing plant Mr. Shoolbred estimates at £2654, and of the new generating plant at £4090—making the total cost £6744. Mr. Baynes, in his report, strongly recommends the adoption of a three-wire system on principles which he lays down. He states that to increase the capacity of the existing mains on the present two-wire system, so as to give a thoroughly efficient service, and provide a good margin to draw on, it would be advisable to double the present feeders, bringing new sets into the town from the works to deliver the currents at points intermediate to the old ones. Such an arrangement, he calculates, would involve an outlay of £8230, and working expenses of £1117; while the commercial limit of distribution would be three-quarters of a mile. The three-wire system he recommends would, he contends, save £366 of capital outlay on the foregoing figures, and £424 per annum in working expenses. The commercial limit of supply would be increased by half a mile, while fewer feeding-mains would be required. Mr. Shoolbred having been asked by the Committee if it would not be advisable to at present limit operations to a three-wire arrangement, with a maximum pressure of 230 volts, instead of a five-wire one with a pressure of double that force, states that probably the larger plan will be found necessary in the long run, and that it would be unwise to "make two bites at a cherry." He, however, expresses the opinion that an expenditure of £2034 in cables, &c., would suffice for the three-wire system, but goes on to say that an expenditure of £1600 in new generating plant should be made to provide for next winter's lighting. Mr. Shoolbred and Mr. Baynes had an interview with Lord Kelvin last Thursday, to ascertain his views as to the best mode of procedure to adopt for increasing the supply of Bradford.

Reconstruction of the Uttoxeter Gas Company.—At a recent extraordinary general meeting of the Uttoxeter Gas Company, it was resolved and confirmed—"That it is desirable to complete the reconstruction of the Company by making over its undertaking and property to the Uttoxeter Gas-Works, Limited; and accordingly that the Company be wound up voluntarily."

The Water Supply of Penrith.—The question of providing Penrith with a new supply of water, which has been much debated by the Local Board during the past eighteen months, and on which Mr. G. F. Deacon (as stated previously in the JOURNAL) has reported, has been settled for a time by the Board resolving to merely put the existing mains and reservoirs in a good state of repair.

Searching for Water with the Divining-Rod.—A firm of contractors at Cardiff recently had occasion to sink a well at Llanishen, and they called in the services of a "diviner." A spot was selected by him where, he said, water would be found at a depth of 20 to 25 feet from the surface. A boring was made, with the result that a strong spring was tapped at a depth of rather more than 20 feet.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The North British Water-Gas Syndicate, or rather, according to the local shareholders, that section of it which is represented by the Directors and those who, along with them, are interested in the subject of water gas apart from the Syndicate, have succeeded in carrying the resolution, proposed some time ago, to amalgamate with the British Water-Gas Syndicate, and the Yorkshire and Lancashire Water-Gas Company. The shareholders met in Glasgow on Thursday, under the chairmanship of Mr. J. Reid Stewart. It was a singular circumstance that at such an important meeting Mr. Samson Fox should not have made an endeavour to be present. Were I a shareholder, I should consider his absence an indication that he took little interest in the Syndicate. The Chairman narrated the steps which have been taken in connection with the proposed amalgamation, which dealt chiefly with the opposition to it originated by Mr. Allan, writer, of Glasgow. He said that Mr. Allan had intimated, on Feb. 11, that Counsel's opinion had been taken, and that it was on every point favourable to resistance; but, on the other hand, the Directors had obtained an opinion from the Lord Advocate in favour of their position. The Chairman seemed to think that he had transfixed the opposition by the Lord Advocate's opinion; but if he did he was deluding himself. The question which the opposition raises is not whether, under the Articles of Association, the shareholders have the power to amalgamate, but whether the whole actings of the Syndicate cannot be set aside on account of mis-statements in the prospectus. The two sets of Counsel were thus on different ground; and both may be right, according to the memorial which was put before them. Of course, the Lord Advocate could not assume that there was mis-statement in the prospectus; and the Directors could not, naturally, for their own credit, ask him to assume it. Mr. Allan made a strong endeavour to get the Leeds Forge Company connected with the promotion of water gas, but failed—as he probably would do in a Court of Law. Though the example of the Leeds Forge Company was cited in the prospectus, and Mr. Samson Fox is both connected with the Forge and a leading promoter of the Syndicate, he doubtless acted in a separate capacity in the two undertakings. The Leeds Forge Company is a successful undertaking; and could it be brought into the swim, its earnings would go a long way to make up for the want of profits elsewhere. But, of course, it is hopeless to expect such a move to be successful. That, perhaps, was not Mr. Allan's intention; he may have only sought directly to discredit Mr. Samson Fox and his coadjutors. Whatever his object, he was able to show that water gas was not the success which it was represented in the prospectus to be, by bringing out the statement that, when the prospectus was printed, it had, in that year, effected a saving of £10,000 at the Leeds Forge. The inference is that it has not resulted in any such saving since; and it is also noticeable that, when the Chairman was asked if he was to introduce it in connection with Siemens plant he is putting down at Wishaw, he could only say "they might do that yet." Surely, if the Chairman had any faith in water gas, he would have no hesitation in saying he would introduce it into his own works. If he does not adopt it, how can he expect others to do so? The complaint was made that, although £140,000 has been drawn from the North British Syndicate, only £20,000 can be accounted for; and it surely would have been courtesy, when this question was raised, to have explained where the money went. If it went into the coffers of the parent Company, somebody must have made water gas pay, although it has not been a profitable process in working. But, of course, the Directors had voting power; and they appeared not to care for too much explanation. They are to raise 10s. per share—for what purpose, they did not say. This seems to amount to £12,000 from the Scotch Syndicate. Now the question may almost be stated in a rule of three problem thus: If £120,000 expended by the Scotch Syndicate has produced no dividend, how much will £12,000 produce. The answer would be a tenth of nothing. This is absurdity; but it shows how questionable it is to seek to raise more capital when nothing has been done with what they have. The dissenting shareholders will not contribute the whole of the £12,000. But if their proportion should be even £2000, that sum would more than cover the costs of litigation; and as they seem to consider that subscribing it to the Syndicate would mean its total loss, they might be well advised if they applied it in testing in the Law Courts whether they can be made to subscribe anything.

The Edinburgh and Leith Gas Commissioners had a short meeting on Monday, at which they sent their accounts for the year to the Finance Committee, to consider what should be done with the surplus of £2488 which arose upon last year's working. After the Commission meeting, the Finance Committee took up the remit, and resolved to recommend that it be carried forward, as the Commissioners did last year with their surplus of £27,180. This gives them a balance in hand of £29,668, which will enable them to work more economically, because, not being locked up in any way, as the sinking funds are, it can be used at any time. As a matter of fact, the having of the £27,180 in hand last year was the means of saving over £800 to the Commissioners, in the way of interest upon short loans from the bank. I understand that the policy which some of the leading members of the Commission favour is the accumulation of a sum of at least £50,000 to be held and used in this way; and to me the policy appears to be a sensible one. The Commissioners have sold their tar to Messrs. James Ross and Company, of Falkirk, the present contractors, upon a sliding scale which has been found to work satisfactorily. In the contract just entered into, a condition has been inserted that the Commissioners are to give three months' notice before beginning to make oil gas; and the price of the products will then be arranged. Another subject of interest was a remit to the Oil Gas Sub-Committee, to consider as to the introduction of mechanical stoking into the works, both in Edinburgh and Leith, and the authorizing the Committee to visit Aberdeen to examine the plant in use there. The Engineers' reports showed an increase of 863,000 cubic feet in the output of gas during May.

The working of a few Scotch Gas Companies calls for notice this week. The Bothwell and Uddingston Gas Company, which the late Mr. Laurence Hislop served so long and faithfully, held their annual meeting on Tuesday. It was reported that the output of gas during the year was 25,452,700 cubic feet, an increase on the preceding year of 1,837,100 cubic feet. The dividend paid was at the rate of 10 per cent. The Chairman made reference to the loss the Company had sustained in the death of Mr. Hislop. The Company are at present seeking interdict in the Lanarkshire Sheriff Court against the County Council, charging them for their water supply "a fixed minimum charge equal to the domestic rate." It is maintained for the Company that they are entitled to a traders' rate. They have been threatened with the cutting off of their water supply; and in order to avoid this, they have offered to consign the necessary amount in Court. The Sheriff heard parties in the case on Tuesday, and reserved judgment. The Dunfermline Gas Company on Wednesday held their second annual meeting since the Company was re-constructed. Notwithstanding the trying year they have come through, in the disablement of their late Manager, Mr. William Mackenzie, and ultimately the loss of him while they were entering upon a scheme of transfer for the works, the Company has continued to prosper. An increase in the sale of gas was experienced to the amount of over 3 million cubic feet; and the balance-sheet brought out a surplus of £3184, as against £2741 last year. These results were obtained, too, in face of a rise of 2d. per 1000 cubic feet in the price of gas, which is now 3s. 9d. During the year, there was a capital expenditure of £1764; the capital account now standing at £38,137. The dividend paid was at the rate of 6 per cent., as against 10 per cent. last year. The Directors of the Galashiels Gas Company, in their annual report, recommend a dividend at the rate of 10 per cent. The profit on the year was £2832. It is also recommended that the price of gas be reduced from 3s. 9d. to 3s. 6½d. per 1000 cubic feet. In Galashiels, the Peebles process of enrichment with oil is now in use. The Directors of the Hawick Gas Company in their report recommend a dividend at the rate of 10 per cent., and the reduction of the price of gas from 3s. 11½d. to 3s. 6½d. per 1000 cubic feet. The reduction is secured by the favourable purchase of coal. The Langholm Gas Company have paid a dividend at the rate of 3 per cent., as compared with 7 per cent. last year; and they have retained the price of gas at 5s. per 1000 cubic feet. It was explained at the recent meeting of shareholders that the decreased dividend was due to the high price of coal and the low price obtained for residuals.

Lord Wellwood, in the Court of Session, on Thursday, disposed of the action by the New Bank Coal Company and William Hislop, of Bank House, New Cumnock, against Robert Marshall, cannel coal merchant, of 97, Wellington Street, Glasgow, in which he heard evidence last March. The dispute arose over a contract entered into in March, 1891, for the supply to the defendant, during the succeeding year, of 5000 tons of the best cannel coal, at 14s. 3d. per ton. Only 3406 tons were taken; and pursuers said they were obliged to sell the remaining 1594 tons at 11s. 3d. per ton. They therefore sued for the difference in price, and 1s. per ton for the cost of binging. The defence was that coal was supplied which was mixed with dirt, common coal, and stone; and that, in consequence of its inferior quality, some of defender's customers cancelled contracts with him. Lord Wellwood's decision is that the pursuers made a mistake in not stating in their accounts, and in the action, that the whole of the coal was raised during the year; and that, as their accounts represented that of the quantity sued for 975 tons were raised during April and May, 1892—which was beyond the year of the contract and could not be taken into account—only the balance of 536 tons, which were raised within the year, was the defender bound to have taken delivery of. As he got warning during the year that if he did not take the coal it would be binged at his expense, he was therefore liable for the charge for binging. As to the complaints regarding inferiority, his Lordship was of opinion that these having ceased months before the end of the contract, the defender, by continuing to take delivery of large quantities of coal, was barred from stating inferiority as a defence. He therefore found Mr. Marshall liable for 536 tons, and gave decree for £109 3s. 1d., and allowed the pursuers four-fifths of their expenses.

The Gas Committee of the Aberdeen Corporation have contracted for 37,500 tons of coal for the ensuing year, at a total cost of £29,450, or about 15s. 8½d. per ton. As compared with current contracts, there is a saving of £7734, or at the rate of 4½d. per 1000 cubic feet of gas. The Aberdeen financial year ends in September.

An important addition was made on Friday to the water supply of Glasgow, in the turning on by Lord Provost Bell of the water in the Duchray and Kelty sections of the new aqueduct which is being constructed from Loch Katrine to the city. Mr. J. M. Gale, M.Inst.C.E., the Engineer to the Corporation, stated that the two sections of the aqueduct were nearly 6½ miles long, or rather more than one-fourth of the whole distance from Loch Katrine to Mugdock. If to this was added the Mugdock tunnel, opened rather more than two years ago, the length completed was one-third of the whole aqueduct. The cost of the Kelty and Duchray sections had been £170,000, or £27,000 per mile. Nearly the whole length had been tunnelled; the tunnels varying from 1½ to 2½ miles in length. The Lord Provost stated that the portion of the works they had opened would enable them to augment the water supply by 10 per cent., and that when the whole works were completed they would be able to increase it from 46 to 110 million gallons per day. The Loch Katrine district would not be able to supply so much water; and, should the consumption demand it, an area with a water supply equal to that of Loch Katrine could be tapped by a tunnel 4½ miles in length, from Loch Katrine to Loch Voil.

The estimates of income and expenditure of the Dundee Water Commission have been made up; and they show a necessity for the raising of the domestic water-rate from 1s. to 1s. 2d. per pound. This large increase is due to the provision which requires to be made for the sinking fund. Up to 1891, the sum annually placed to the fund was £2500; and this year it will be £5690. A total revenue of £48,145 is estimated for; and a total expenditure of £48,041—leaving an apparent surplus of £105. The water-rate in 1888-9 was 1s. 2d. per pound; in 1889-90, it was 1s. 1d.; and it has since been 1s. The increase this year therefore is but a return to the rate four years ago.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *July* 1.

Sulphate of Ammonia.—Some further improvement has taken place in consequence of the impetuous competition for the supplies which have been offered; and every available parcel has been snapped up. It is a matter of satisfaction that, even at the present high values, consumers have continued to purchase; and, if not driven too hard, the market is likely to maintain its healthy tone during the lightest months of production. The quotations are now £13 to £13 2s. 6d. Liverpool and Hull; and £13 2s. 6d., Leith. Forward delivery is not so much inquired for; and there are now quotations at £12 2s. 6d. October-March. The delay in arrival of due cargoes of nitrate has caused the stocks locally to become very low; hence holders, taking advantage of the situation, have raised the price to 9s. 6d. and 9s. 9d.

LONDON, *July* 1.

Tar Products.—Very considerable quantities of benzols have been sold during the past week at miserably low prices, which must, in many cases, leave the sellers a very serious loss, some of whom, it is reported, have been stocking benzols for several months. Tar contracts are being let at extremely low prices, compared with former years; but, with the low values of products, and the poor demand, it is difficult to see how profit will be made even at the low prices offered. A better inquiry exists for carbolic acid; but singularly, although there are no stocks, and it is known that enormous quantities are being used, prices do not advance, as had been anticipated. To-day's nominal prices are: Tar, 10s. to 12s., according to position. Pitch, 23s. 6d. Benzols, 90's, 1s. 6d.; 50's, 1s. 5d. Solvent naphtha, 1s. 0½d. Toluol, 1s. 4d. Crude benzol naphtha, 30 per cent., 7½d. Creosote, 1d. Salts, 16s. Carbolic acid, 60's, 1s. 10d.; 70's, 2s. 2d.; crystals, 7d. Cresol, 1s. 8½d. Anthracene, nominal, 30 per cent. "A," 1s.; "B," 8d.

Sulphate of Ammonia.—The rumour of restricted shipments of nitrate is now definitely confirmed. There is already, and there will be a further advance in the value of nitrate. This will materially help sulphate. The weak feature about the recent advances in ammonia products has been that, while the advance took place, nitrate simultaneously decreased in value. Stocks of sulphate are so low, and the demand for Continental consumption appears to be so urgent, that there can be no doubt that sulphate will, for some time to come, maintain its improved value. Business has been done during the week at prices ranging from £13 to £13 5s., less 3½ per cent. Gas liquor is quoted at 8s. 6d. to 9s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The chief matter just now engaging attention is the proposed reduction of 25 per cent. in miners' wages; and where gas-coal contracts have not yet been settled, this will no doubt induce buyers to hold back in the expectation that, should any really tangible reduction in wages be secured, it will have some effect in further easing down prices. Colliery owners, however, state that it is the very considerable fall in prices which has already taken place, that has rendered the reduction necessary; and that any advantage they may be able to gain has already been fully discounted. With regard to many of the gas-coal contracts for which tenders have been sent in, settlements are only being very slowly arrived at; and gradually 1s. 6d. per ton under last season's prices is becoming more nearly the average basis upon which business is being done. As far as rates can be quoted, they are about 7s. to 7s. 3d. for common gas coal; and from 8s. 3d. up to 8s. 9d. in special cases for the best screened Wigan gas coal, at the pit mouth. With regard to all other descriptions of round coal, extreme depression continues to be reported. Best Wigan Arley coal averages about 11s.; Pemberton four-feet and seconds Arley, 8s. 6d. to 9s.; common house-fire coals, 7s. 3d. to 7s. 6d.; and steam and forge coals, 6s. 3d. to 6s. 6d. per ton at the pit mouth. The very small output of slack, owing to the depressed condition of the round coal trade, causes a continued scarcity of engine fuel; and consumers have a difficulty in covering requirements. It is, however, only in special cases that any further advanced prices are obtainable. At the pit mouth, burgy remains at about 6s. 3d. to 6s. 9d.; best slack, at 5s. 3d. to 5s. 9d.; medium, 4s. 6d. to 4s. 9d.; and common, 3s. 6d. to 4s. per ton.

Northern Coal Trade.—The coal trade is steadier than it has been; and there are rather heavier demands from home consumers, who appear to dislike the appearances of the labour prospects in the coal trade. Best Northumbrian steam coals are now quoted generally at 9s. per ton f.o.b.; and in one or two cases a rather larger price has been paid for early delivery. Second-class steam coals are 8s. 3d. per ton; and small steam coals are plentiful at 3s. 6d. per ton. Manufacturing coals are quiet; but the demand does not show much diminution. Gas coals are slightly steadier, as besides a more general disposition to stock coal, there is also an inclination to prepare for possibilities owing to the threatening nature of the relations between employers and employed in the coal trade. It seems to be feared that some stoppages of production may result. The price of best Durham gas coals may now be put as from 6s. 3d. to 6s. 6d. per ton, in most instances; but one or two collieries that are exceptionally situated ask 7s. per ton f.o.b. For best Durham coke, the demand is steady and larger than it was, both for shipment and for home use. For export, the price asked is about 14s. per ton f.o.b. The better prospects of the iron trade seem to have given more life to the coke market generally. Gas coke is being exported in rather larger quantities; but the price shows no material alteration from last week, and is still very low for large quantities sold under contract.

Scotch Coal Trade.—None but the most pronounced supporters of the restrictive policy can fail to observe that a serious time is in store for both masters and men in Scotland. The operation of the restriction has been to produce a scarcity in some varieties—particularly in splint; and if the men were unanimous they might be able to force a rise of wages. But unfortunately for themselves they are not. While four days a week is being worked generally, in Fifeshire the men are working five days. Meantime, while the situation is critical, prices have scarcely varied. The quotations are: Main, 6s.; ell, 7s. to 7s. 3d.; splint, 7s.; and steam, 7s. 9d. per ton f.o.b. Glasgow. The shipments during the past week amounted to 140,926 tons—a decrease on the preceding six days of 19,924 tons, and as compared with the corresponding week of last year of 7768 tons. There were large fallings off everywhere except in Fifeshire, where the increased export amounted to about 16,000 tons. For the year to date, the total shipments have been 3,128,806 tons—a decrease when compared with the same period of last year of 377,240 tons.

South African Gas Company, Limited.—A return of surplus assets of this Company, which is now in liquidation, is being made to the shareholders by the Liquidator, Mr. Samuel Wood (of Messrs. Alfred Lass, Wood, and Co., Chartered Accountants, of 30, Gracechurch Street, E.C.). The shareholders are receiving fully paid-up shares in the Cape Town and District Gas Company, Limited, in the proportion of one £10 Cape Town share to six £5 South African shares, or the nominal value of 6s. 8d. in the pound. Fractional certificates are redeemable on or before the 31st inst.

Gas-Meter Testing in Manchester.—At a special meeting of the Manchester Justices, on Monday last week, the report of the Assistant Official Inspector of Gas-Meters (Mr. H. Gollings) for the year ending March 31 last was received. It stated that the number of meters tested was 11,660, as against 11,346 in the preceding year—being an increase of 314. The fees charged amounted to £442 9s., against £408 19s.—being a gain of £33 10s. The cash statement of receipts and expenditure showed a net loss on the twelve months' work of £298 7s. 11d. Of 11,660 meters tested, 591 were rejected, or 5·06 per cent., as against 4·27 per cent. in the previous year. The total consisted of 57 new wet meters, 104 old wet meters, 207 new dry meters, and 223 old dry meters. The grand total of meters tested since the Act came into operation in 1862 was 294,069; the fees amounting to £9435.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 25.)

Issue.	Share	When ex-Dividend.	Dividend on Last Issue.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	13 Apl.	10½	Alliance & Dublin 10 p. c.	10	15½—17½	..	6 0 0
100,000	10	"	7½	Do. 7 p. c.	10	11½—12½	..	6 0 0
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	102–104	+½	4 16 2
100,000	20	31 May	8	Bahia, Limited	20	10½—11½	..	13 18 3
200,000	5	12 May	6½	Bombay, Limited	5	5½—6	..	5 8 4
40,000	5	"	6½	Do. New	4	3¾—4¼	..	6 2 6
380,000	Stck.	24 Feb.	11½	Brentford Consolidated	100	222—227	+2	5 1 4
180,000	"	"	8½	Do. New	100	168—173	..	4 18 3
220,000	20	15 Mar.	11½	Brighton & Hove Original	20	41—43	..	5 6 11
888,500	Stck.	31 Aug.	5	Bristol	100	104—107	..	4 13 5
320,000	20	13 Apl.	11½	British	20	42—44	—½	5 4 7
50,000	10	15 Mar.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	"	8½	Do. 7 p. c.	10	15—16	..	5 6 3
328,750	10		—	Buenos Ayres (New) Limited	10	6¼—6¾	..	—
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	97–100*	..	6 0 0
150,000	20	24 Feb.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	28 Apl.	12½	Commercial, Old Stock	100	245—250	..	5 0 0
165,000	"	"	9½	Do. New do.	100	182—187	..	5 1 7
162,762	"	15 June	4½	Do. 4½ p. c. Deb. do.	100	125—130	..	3 9 3
800,000	Stck.	15 June	13	Continental Union, Limited	100	227—232	..	5 12 0
200,000	"	"	10	Do. 7 p. c. Pref	100	190—195	..	5 2 7
75,000	Stck.	15 Mar.	10	Crystal Palace District	100	190—195	..	5 2 7
486,090	10	27 Jan.	10	European, Limited	10	21½—22¼	—¼	4 8 11
354,060	10	"	10	Do. Partly paid	7½	15—16	..	4 13 9
5,596,560	Stck.	10 Feb.	12	Gaslight & Coke, A, Ordinary	100	224—229	—1	5 4 10
100,000	"	"	4	Do. B, 4 p. c. max.	100	95—99	..	4 0 10
665,000	"	"	10	Do. C, D, & E, 10 p.c. Pf.	100	263—268	..	3 14 7
30,000	"	"	5	Do. F, 5 p. c. Prf.	100	120—125	..	4 0 0
60,000	"	"	7½	Do. G, 7½ p. c. do.	100	170—175	..	4 5 8
1,300,000	"	"	7	Do. H, 7 p. c. max.	100	170—175	..	4 0 0
463,000	"	"	10	Do. J, 10 p. c. Prf.	100	262—267	..	3 14 10
476,000	"	"	6	Do. K, 6 p. c. Prf.	100	156—160	..	3 15 0
1,061,150	"	15 June	4	Do. 4 p. c. Deb. Stk.	100	125—128	..	3 2 6
294,850	"	"	4½	Do. 4½ p. c. do.	100	128—132	..	3 8 2
908,000	"	"	6	Do. 6 p. c. do	100	167—172	..	3 9 9
3,800,000	Stck.	12 May	12	Imperial Continental	100	224—229	—1	5 4 10
75,000	5	15 June	6	Malta & Mediterranean, Ltd.	5	5—5½	..	5 9 1
560,000	100	4 Apl.	5	Met. of Melbourne, 5 p. c. Deb.	100	103—105	..	4 15 3
541,920	20	15 June	5	Monte Video, Limited	20	13—14	..	7 2 10
150,000	5	31 May	10	Oriental, Limited	5	7⅞—8	..	6 5 0
60,000	5	29 Mar.	7	Ottoman, Limited	5	4¼—4½	..	7 3 8
166,870	10	—	2	Pará Limited	10	2—2½	..	—
420,000	100	2 May	6	People's Gas of Chicago— 1st Mtg. Bds.	100	100—105	..	5 14 3
500,000	100	1 June	6	2nd Do.	100	98—102	..	5 17 8
150,000	10	28 Apl.	5	San Paulo, Limited	10	8½—9½	..	5 5 3
500,000	Stck.	24 Feb.	15½	South Metropolitan, A Stock	100	297—302	+3	5 2 8
1,350,000	"	"	12	Do. B do.	100	244—248	..	4 16 9
230,000	"	"	13	Do. C do.	100	250—255	..	5 1 11
750,000	"	13 Jan.	5	Do. 5 p. c. Deb. Stk.	100	148—152	..	3 5 9
60,000	Stck.	15 Mar.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
744,897	Stck.	29 June	10	Chelsea, Ordinary	100	257–262*	..	3 16 3
1,720,252	Stck.	29 Mar.	8	East London, Ordinary	100	204—209	—3	3 16 7
544,440	"	29 June	4½	Do. 4½ p. c. Deb. Stk.	100	140–143*	..	3 2 11
700,000	50	15 June	8½	Grand Junction	50	107—110	..	3 17 2
708,000	Stck.	10 Feb.	11	Kent	100	280—285	..	3 17 2
1,043,800	100	29 June	9½	Lambeth, 10 p. c. max.	100	232–237*	..	4 0 2
406,200	100	"	7½	Do. 7½ p. c. max.	100	195–200*	..	3 15 0
310,000	Stck.	29 Mar.	4	Do. 4 p. c. Deb. Stk.	100	129—132	..	3 0 7
500,000	100	10 Feb.	12½	New River, New Shares	100	329—334	..	3 12 8
1,000,000	Stck.	27 Jan.	4	Do. 4 p. c. Deb. Stk	100	133—137	..	2 18 5
902,300	Stck.	15 June	6	S'thwk & V'xhall, 10 p. c. max.	100	147—152	..	3 18 10
126,500	100	"	6	Do. D 7½ p. c. do.	100	140—145	..	4 2 9
1,155,066	Stck.	15 June	10	West Middlesex	100	253–258	..	3 17 6

*Ex Div

Water Supplies and the Drought.—The heavy rains which fell during the early part of the past week throughout the country appear to have had very little effect on the supplies of water. Many local authorities continue to regard the outlook with some anxiety, and still impress upon householders the necessity of exercising the utmost economy.

Gas Consumers and Deposits.—The Manager of the Huddersfield Corporation Gas-Works (Mr. W. R. Herring) has submitted to his Committee a list of consumers who have left the town without applying for a return of the money they had deposited with the Corporation as security for the payment of their gas accounts; the total amount being about £1100.

Wath Gas Company.—The annual meeting of this Company was held on Monday last week, when the report submitted showed an income during the year (including the balance of £184 brought forward) of £2233. The expenditure amounted to £1338; so that there was £895 available for division. The report was adopted; and a dividend of 7½ per cent. was declared.

Stoke Corporation Gas Supply.—At the last monthly meeting of the Stoke Town Council, the Gas Committee recommended that £1000 should be remitted to the Corporation on account of the current year's profits. Alderman Faram, in moving the adoption of the recommendation, said the audit on the gas accounts had just been completed; and the Council would be pleased to hear that the profits for the year were £526 more than those for the preceding twelve months. The gross profits amounted to £6474; making a net profit of a little more than £3000. The recommendation was adopted.

The Manchester Ship Canal and Sewage Disposal.—The approaching completion of the Manchester Ship Canal has had the effect of compelling the various Local Authorities on the Irwell to take steps to purify their sewage before discharging it into the river. The Manchester sewage works will shortly be completed; and, as our readers are aware, Salford has for some time been experimenting with various processes for effectually treating the sewage of the borough, which amounts to some 10 million gallons per day. The disposal of the sludge is, however, in many cases a very troublesome problem; and, with a view to solving the difficulty at Salford, Messrs. J. Taylor, Sons, and Santo Crimp, of Westminster, have been requested to advise the authorities thereon.

The Electric Lighting Installation for Lancaster.—At Lancaster last Thursday, Major-General Crozier, R.E., held an inquiry, on behalf of the Local Government Board, into an application which had been made by the Town Council for sanction to borrow £25,000—the estimated cost of a system of electric lighting for the borough, to be provided by the Brush Electrical Engineering Company. For the present the Corporation propose to light only the main streets in the centre of the town; but arrangements are being made so that the additional plant may be put down as required.

The Tenders for a New Reservoir for Bradford.—A special meeting of the Bradford County Borough Council was held last Saturday week to consider a recommendation of the Water Committee that the tender of Mr. John Best, of Edinburgh, for the construction of a compensation reservoir at Gouthwaite, in the Nidd Valley, for the sum of £118,551, be accepted. In moving the adoption of the recommendation, Alderman Holdsworth, the Chairman of the Committee, remarked that the amount of the tender was somewhat less than the tender prepared in the office; but it was not the lowest submitted, as that had since been withdrawn. It was the second lowest out of seventeen. It was below the estimate that he had formed, and below that of their Engineer. The motion, having been seconded by Alderman Smith Feather, was carried *nem. con.* A short discussion was subsequently initiated by Alderman Holdsworth on the subject of the publication of the list of tenders and their amounts. He stated that the Bradford press was anxious to publish them; and applications for similar lists had been made by professional journals. He did not think there would be any risk in issuing the lists; but he wanted to be on the right side. Alderman Smith Feather said he considered it would be very foolish, for two very important reasons, to publish the lists in these cases. One was that those who tendered too high would be made to look ridiculous; and those who had sent in low tenders might be disposed to withdraw. The Mayor (Mr. W. Oddy) thought the publication of the lists would be a new departure, out of which no good would come. Alderman Holdsworth said for himself he would have no hesitation in publishing the list if the legal documents in connection with the accepted tender were complete—in fact, he would rather recommend it to be done. Mr. J. S. Toothill believed it was usual to publish lists of this kind in professional journals. Mr. Crossland thought the advice of the Chairman might be taken; and the list not published till after the accepted contract had been signed. The matter then dropped.

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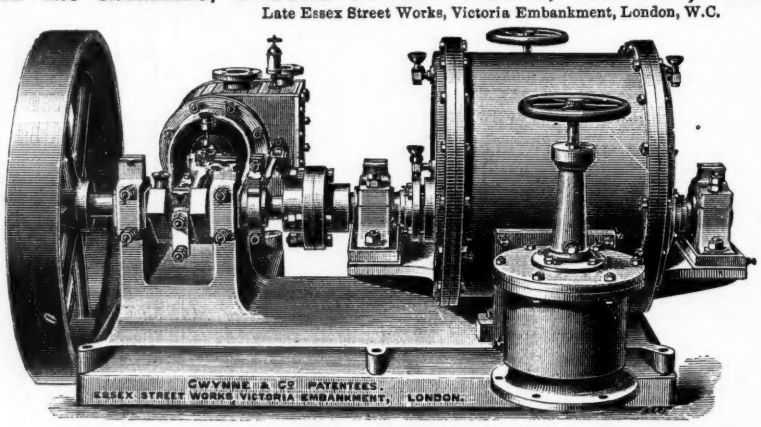

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Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

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Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors, for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks. Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."

CHARTERING, FORWARDING, AND INSURANCE.

ROBERT BRUCE FITZMAURICE, 29, Great St. Helens, London, Shipping Agent to several Gas Companies and Plant Manufacturers, would be glad to UNDERTAKE LARGE or SMALL SHIPMENTS to any Port.

WANTED. Gas Liquor.
Address GEORGE DOBSON, LIMITED, CARDIFF.

WANTED, a Situation as Manager of a Tar Distillery, at either a Gas-Works or Private Yard. Advertiser has a thorough practical knowledge of every branch of Tar Distilling and Ammonia Making. Could undertake erection of a new Plant.
Address J. LIGHTFOOT, 3, Christ Church Terrace, ACCRINGTON.

ADVERTISER (26) desires Appointment as ASSISTANT MANAGER of Gas-Works. All-round experience, including Sulphate making, Chemist, used to Plans, a Silver Medallist (Honours) in "Gas Manufacture," City and Guilds of London Institute. Good references. Abstainer. Wishes to change to widen experience.
Address No. 2254, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a steady, reliable Gas Stoker, used to Shovel Charging. Good wages and constant employment. Total abstainer preferred.
Apply, by letter, to E. G. SMITHARD, Gas-Works, CHELMSFORD.

WANTED, by a Gas Company near London, a PRODUCTS CLERK.
State particulars, experience, and salary required, to No. 2256, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, first-class Retort Setters. Regular employment.
Apply, with full particulars of age, where last employed, and whether Society or Non-Society, to No. 2251, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

STOKERS.

WANTED, early in August, Two or Three steady and industrious Men, used to Shovel Charging, Engine Exhaust, &c. Testimonials required. Wages from 30s. to 35s. per week.
Address No. 2255, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

EAST DEREHAM LOCAL BOARD GAS-WORKS.

WANTED, a steady, sober Man as STOKER and GENERAL HAND. One used to Regenerative Furnaces and an Exhauster. Wages 23s. per week.
Applications, endorsed "Stoker," to be sent to
A. DRAGE,
Manager.

BRAZILS.

TO MANUFACTURERS AND OTHERS.

CONTINENTAL Firm of standing, with several Branch Houses in the Brazils, is open to make arrangements with Manufacturers and others, either as MERCHANTS, AGENTS or EXCLUSIVE BUYERS.
Payments could be made in Europe.
First-rate English references given and asked.
Address, by letter, "HILD," care of Bates, Hendy, and Co., 37, Walbrook, LONDON, E.C.

SECOND-HAND Gas-Meters wanted to pass 600 to 1000 cubic feet per hour, with 3-inch or 4-inch Connections.
Apply to JOHN DENNIS, DALKEITH.

WANTED, a good second-hand Livesey WASHER, to pass 45,000 feet of Gas per hour.
Apply, by letter, stating full particulars, to No. 2253, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO BE SOLD—Four 14 feet Square PURIFIERS, with Tee-Bars, Stands, and four Tiers of Wood Sieves to each, complete with Wrought-Iron Covers, Air-Plugs, Test-Cocks, Fasteners, also suitable Lifting Apparatus, delivered and erected for the sum of £250 net. Removed to make room for a larger size.
Apply to W. C. HOLMES AND CO., Gas Engineers and Contractors, HUDDERSFIELD.

MR. J. C. CHAPMAN, Fellow of the Chartered Institute of Patent Agents, advises on all matters connected with LETTERS PATENT FOR INVENTIONS and the PROTECTION OF TRADE MARKS, &c., at home and abroad. Preliminary Information and Handbook on application.
70, Chancery Lane, LONDON, W.C.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works sundries.
Telegrams: "HUTCHINSON BROS., BARNSLEY."

JOHN RILEY & SONS, Chemical Manufacturers, Hapton, near Accrington, are MAKERS of SULPHURIC ACID, from Brimstone, for Sulphate of Ammonia making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol. References given to Gas Companies.

GOLD MEDAL, 1892.

TUBES and Fittings for Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.
JOHN SPENCER, Globe Tube Works, WEDNESBURY; and 14, Great St. Thomas Apostle, LONDON.

EXHAUSTER (Rotary), perfectly New (Makers, Dempster and Sons), 20,000 cubic feet per hour, ON SALE, cheap.
Apply to T. G. MARSH, 41, Corporation Street, MANCHESTER.

FOR SALE—Purifier-Valve (Four-way), 6-inch, by Cockey, Frome. In good condition.
METERS, second-hand, two and three light; surplus stock.
Apply to the SECRETARY, Gas Company, Solihull, WARWICKSHIRE.

TO BE SOLD, cheap—A Counter- balanced GASHOLDER, 34 feet diameter by 11 feet deep, in a Cast-Iron Tank, lying now at the Leominster Gas-Works. All in good condition.
Please communicate with No. 2250, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

ALDERSHOT GAS AND WATER COMPANY.

KIRKHAM'S Scrubber, with 8-inch Connections, and four 12 feet square PURIFIERS to be Sold.
Offers to be addressed to the HONORARY SECRETARY, at the Offices of the Company, 103, Victoria Road, ALDERSHOT.

RAILWAY TANK-WAGGONS.

THE Advertiser is prepared to Sell or LET ON HIRE two RAILWAY TANK-WAGGONS, nearly new. Suitable for Tar or Gas Water, &c.
Address No. 2237, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE, the following second-hand GAS PLANT:—
GASHOLDER, 35 ft. by 14 ft.
GASHOLDER and Cast-Iron TANK, 30 ft. by 17 ft.
Four PURIFIERS, 12 ft. square by 4 ft. 6 in. deep.
Cast-Iron SCRUBBER, 36 ft. high by 10 ft. diameter.
CONDENSERS to pass 500,000 cubic feet per diem.
EXHAUSTER to pass 20,000 cubic feet per hour.
Also various other sizes of above or any Gas Plant. Inquiries invited.
Apply to SAML. WHILE, 60, QUEEN VICTORIA ST., E.C.

SPECIAL BARGAIN.

FOR SALE—Two perfectly new Cast- Iron SCRUBBERS, 10 feet diameter by 50 feet high, with Wrought-Iron Domes, Cast-Iron Spiral Staircase, &c., complete. All plates machine planed. One or both Scrubbers will be sold to suit purchasers.
A perfectly new 30,000 per hour HORIZONTAL DOUBLE PUMP RECIPROCATING EXHAUSTER, with Steam-Engine, with Connections and Valves.
One Second-hand (thoroughly overhauled) VERTICAL PUMP EXHAUSTER, with Steam-Engine (with clean Water and Liquor Pumps attached), to pass 7000 cubic feet of Gas per hour.
One Second-hand (thoroughly overhauled) ROTARY EXHAUSTER, to pass 7000 cubic feet per hour (without Engine), fitted with Pulleys.
The whole of the above Plant can be inspected, and full particulars with prices will be sent, on application to No. 2241, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

RUSHDEN AND HIGHAM FERRERS DISTRICT GAS COMPANY, LIMITED.

REMAINDER OF PLANT FOR SALE.
SITE MUST BE CLEARED. NO REASONABLE OFFER REFUSED.

ONE Two-Lift Gasholder, new in 1888.
Makers, R. and J. Dempster. Outer lift, 35 ft. by 15 ft.; inner do., 33 ft. 6 in. by 15 ft.
One Single GASHOLDER, 30 ft. by 12 ft., thoroughly overhauled in 1887 by Messrs. R. and J. Dempster (New Columns, and Guide-Framing).
The above are in excellent condition and well worth the attention of any persons requiring Gasholders of the above capacity.
For particulars and permission to view, apply to JNO. T. LEWIS, Gas-Works, WELLINGBOROUGH.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TENDERS FOR COAL AND CANNEL.

THE Directors of the Radcliffe and Pilkington Gas Company invite TENDERS for a Twelve Months' supply of COAL and CANNEL.
Particulars may be obtained from the undersigned, to whom endorsed tenders must be sent not later than Thursday, the 6th day of July next.
JAMES BRADDOCK,
Manager and Secretary.
Gas-Works, Radcliffe,
June 26, 1893.

OSWALDTWISTLE LOCAL BOARD.

THE Gas Committee invite Tenders for the TAR and LIQUOR produced at their Works for One Year from the 31st day of July, 1893.
The quantity of Coal carbonized is over 3500 tons.
Further Particulars may be obtained from the Manager, Gas-Works, Church, near Accrington.
Endorsed tenders to be addressed to me and to be delivered not later than Wednesday, the 19th of July.
WM. SANDEMAN,
Clerk.
Local Board Offices, Oswaldtwistle,
June 13, 1893.

BOROUGH OF BANGOR.

THE Gas Committee are prepared to receive TENDERS for the supply of from 2000 to 3000 tons of best screened GAS COAL, to be delivered at the Bangor Station, L. & N. W. Railway, or on the Beach at Bangor, during the Twelve Months commencing the 1st day of September, 1893.
Each tender to be accompanied by a printed analysis of the Coal tendered for.
Forms of Tender and other Information may be obtained from the undersigned, to whom tenders are to be addressed, sealed and endorsed "Tender for Coal," not later than July 20, 1893.
The Gas Committee do not pledge themselves to accept the lowest or any tender.
JOHN SMITH,
Manager.
Bangor, July 1, 1893.

MILFORD IMPROVEMENT ACT, 1857.

TENDERS FOR GAS AND STEAM COAL.

THE Milford Improvement Commis- sioners are prepared to receive TENDERS for about 600 tons of large trough and small GAS COAL, and about 70 tons of good BITUMINOUS STEAM COAL, to be delivered between the 1st of September, 1893, and the 1st of September, 1894.
The whole of the Coal to be fresh hewn, clean, and free from Impurities.
Further Particulars and Forms of Tender can be obtained on application to the undersigned.
Sealed tenders, endorsed "Tender for Coal," addressed to the Chairman, Gas and Water Committee, to be sent in not later than the 15th of July next.
The Board do not bind themselves to accept the lowest or any tender.
By order,
THOMAS H. LEWIS,
Clerk.
Milford Haven, June 29, 1893.

TENDERS FOR GAS COAL.

THE Gas Committee of the Town Com- missioners of Newry invite TENDERS for the supply of from 3000 to 3600 tons of GAS COAL, to be delivered in such quantities as may be required by the Committee, and delivered free *ex* Ship or Steamer at Albert Basin, Newry, or f.o.b. at their Shipping Port.
The Coal to be fresh wrought, dry, and free from Clench, Pyrites, or other objectionable matter for Gas Making.
The Committee would assist the Contractor by allowing him to deliver about 1200 tons of Coal prior to the 1st of November next.
Further Particulars may be obtained from Mr. A. Gibb, Manager.
Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, and where raised, to be addressed to the Chairman, and delivered to the undersigned not later than Ten a.m., on Friday, the 7th of July next.
The Committee reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.
By order,
R. H. DOHERTY,
Town Clerk.
Commissioners' Offices, Newry,
June 23, 1893.

TENDERS for the Lighting by Gas or ELECTRICITY of the CITY OF BELEM, the Capital of Gram Pará, Brazil, BY CONTRACT.

The Conditions of Contract and all Particulars may be had on application to the BRAZILIAN CONSULATE, at 6, Great Winchester Street, LONDON, E.C., or at the CONSULATES of LIVERPOOL and GLASGOW.

TENTERDEN GAS AND COKE COMPANY.

THE above Company invite Tenders for 400 tons of good GAS COAL, to be delivered at Headcorn or Appledore Station, S.E.R. 200 tons to be delivered in August, and the remainder as required.

Sealed tenders to be sent to the Secretary on or before the 14th of July next.

June 24, 1893.

TENDERS FOR OXIDE OF IRON.

THE Directors of the Bath Gaslight and Coke Company invite TENDERS for the supply of 250 tons of OXIDE OF IRON.

Full Particulars and Form of Tender may be obtained on application to Mr. C. S. Ellery, the Company's Engineer.

Tenders, endorsed "Tender for Oxide of Iron," to be sent in, addressed to the undersigned, not later than Twelve o'clock (noon) on Monday, the 10th day of July.

The Directors do not bind themselves to accept the lowest or any tender.

GEORGE HELPS,
Secretary.

Gas Company's Office, Bath,
June 30, 1893.

TENDERS FOR GAS COAL.

THE Directors of the Bath Gaslight and Coke Company invite TENDERS for the supply of about 42,000 tons of GAS COAL, screened or unscreened, upon Contracts of 3000 tons, or multiples of that quantity, during the Year commencing the 1st of July, 1893.

Full Particulars and Form of Tender, may be obtained on application to Mr. C. S. Ellery, the Company's Engineer.

Tenders, endorsed "Tender for Gas Coal," to be sent in, addressed to the undersigned, not later than Twelve o'clock (noon) on Monday, the 10th day of July.

The Directors do not bind themselves to accept the lowest or any tender.

GEORGE HELPS,
Secretary.

Gas Company's Offices, Bath,
June 30, 1893.

THE Elland-cum-Greetland Gas Company offer for SALE BY TENDER, pursuant to the Provisions of the Elland Gas Order, 1878, on the 14th day of July, 1893, in lots of 10 Shares each, about 820 NEW PREFERENCE SHARES of £10 each, bearing a fixed Preferential Dividend of 4½ per cent. per Annum, contingent upon, and payable out of, the profits of each Year.

The Company's Acts of Parliament and published Statements of Account may be inspected, and printed Particulars and Conditions of Sale may be obtained, on application to Mr. Robert Porter, Engineer and Secretary, Gas-Works, Elland, Yorkshire; or to

LANCASTER AND WRIGHT,
Solicitors.

10, Piccadilly, Bradford,
June 2, 1893.

WALLINGFORD GASLIGHT AND COKE COMPANY, LIMITED.

TENDERS FOR GAS COAL.

THE Wallingford Gaslight and Coke Company, Limited, invite TENDERS for the supply for One Year, from the 12th of August next, of about 900 tons of best screened GAS COAL, to be delivered free, at the Railway Station at Wallingford, in such quantities and at such times as the Company may require.

Payments monthly.

Sealed tenders, endorsed "Tender for Gas Coal," to be delivered on or before the 31st of July next.

The Company do not bind themselves to accept the lowest or any tender.

By order,
JOHN CARTHEW,
Secretary.

Wallingford, June 20, 1893.

BY ORDER OF EXECUTORS AND OTHERS.

WEST HAM GAS COMPANY—ROMFORD GAS COMPANY—COMMERCIAL BREWERY COMPANY, LIMITED.

MR. ALFRED RICHARDS will Sell by Auction at the Mart, E.C., on Tuesday, July 11, at Two, in Lots, 255 ORIGINAL £5 FULLY-PAID SHARES in the West Ham Gas Company, 70 "B" SHARES in the Romford Gas Company, and 60 £10 SEVEN PER CENT. PREFERENCE SHARES in the Commercial Brewery Company, Limited.

Particulars of Messrs. HILLEARY, Solicitors, 5, FENCHURCH BUILDINGS, E.C.; of Messrs. WARNER AND HETLEY, Solicitors, 4, Raymond Buildings, GRAY'S INN, W.C.; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

Price 2s. per dozen, or 10s. 6d. per 100, post free.

CONSPIRACY and Protection of Property Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

*** *The Act extends to Scotland and Ireland.*

CASES FOR BINDING VOLUMES OF THE "JOURNAL"

(GREEN CLOTH, GILT LETTERED)

Price 2s. each.

For **FIRE-BRICKS**, the most durable for **GAS-FURNACES**,

ADDRESS

JAMES WHITE & Co., Limited,
ALBERT WORKS, WIDNES.

AUG. KLÖNNE,
DORTMUND (GERMANY).

REGENERATIVE FURNACES.

Unsurpassed in Efficiency, Economy, Durability, and Easy Working.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

MEIKLEJOHN'S PATENT
Improved Slide-Valve Anti-Dip.

Is perfectly reliable in action, and requires no attention. Has all the advantages of the Dip and Anti-Dip combined.

Is cheap and easily fixed to any form of main.

Will be found the most efficient appliance of the kind yet introduced.

Further particulars and price from

C. MEIKLEJOHN,
GAS-WORKS, RUGBY.
(Late N. MEIKLEJOHN, Longwood.)

NIDDRIE CANNEL

A FIRST-CLASS CANNEL COAL,

Yielding a large volume of rich Gas, and fully 60 per cent. of first-class Coke.

FOR ANALYSIS, PRICE, AND ALL OTHER PARTICULARS, APPLY TO

The Niddrie & Benhar Coal Co., Ltd.,
15, HANOVER STREET,
EDINBURGH.

Telegrams: "BENHAR, Edinburgh."

T. B. KITTEL, SHEFFIELD.

CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL

ENGLISH & SCOTCH CANNELS.

REAL SILKSTONE GAS COAL

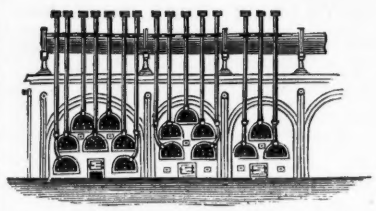
ANALYSIS AND PRICES ON APPLICATION.

T. B. KITTEL, SHEFFIELD.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application.

DEMPSTERS'



RETORT-SETTINGS,

RETORT-FITTINGS,

ELLAND.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON AND COAL COMPANY, Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

The Analysis made by Messrs. J. and H. T. Pattinson, Public Analysts for Northumberland, gives 10,500 cubic feet of Gas per ton, with an Illuminating Power of 16·3 Candles and 67·3 per cent. of Coke. The following is a Working Analysis made of these Coals by the Tudhoe and Sunderland Bridge Gas Company:—

[COPY.]

TUDHOE AND SUNDERLAND BRIDGE GAS COMPANY.
Tudhoe Gas-Works,
Spennymoor,
8th June, 1893.

Messrs. The
WEARDALE IRON & COAL COMPANY, LTD.
GENTLEMEN,

For the last two months we have used your **THORNLEY GAS COAL** exclusively at these gas-works; and I have pleasure in herewith giving you the actual results obtained during the trial.

Yield of Gas per ton: 10,300 cubic feet.

Yield of Coke: 13½ cwt.

Illuminating Power of Gas, average of a series of tests, **17 Sperm Candles.**

The Coke was of excellent quality.

The following is a complete ultimate Analysis of the Coal.

	PER CENT.
Carbon	83·128
Hydrogen	5·116
Oxygen	7·401
Nitrogen	0·585
Sulphur	0·620
Ash	3·130
Water	0·020
	100·000

Analysis of the Coke.

Carbon	93·31
Sulphur	0·61
Ash	5·00
Moisture	1·08
	100·00

I am, Gentlemen,
Yours truly,
A. B. COWAN,
Manager.

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.,
QUAYSIDE, NEWCASTLE-ON-TYNE.

HUNTER'S
OXIDE OF IRON.
JAMES HUNTER, LESSEE, MINER, AND SHIPPER OF NATURAL IRISH BOG ORE.
This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.
Samples and Prices on application.
11, BAY STREET, PORT GLASGOW.
Telegrams: "HUNTER PORT GLASGOW."
Established 1872.

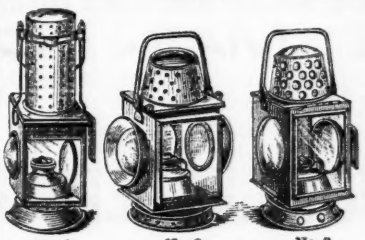
BOLDON GAS COALS.
Worked by THE HARTON COAL CO., LTD.,
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to
The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Ipswich Gaslight Company, Devonport Gas Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.
For prices, &c., apply to the
HARTON COAL COMPANY, LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON, FITTER.

HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)
PRESENT production over 3200 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16¼ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves about 70 per cent. of excellent Coke. To show the progress of HOLMSIDE COALS, it may be mentioned that the quantity carbonized by the London Gas Companies in 1885 was about 200,000 tons; whereas the present consumption of HOLMSIDE COALS in London alone is at the rate of over
400,000 Tons per Annum.
Full particulars on application to
MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-ON-TYNE.

ARMSTRONG'S PATENT
CANDLE SAFETY LAMPS

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43, MANCHESTER STREET, GRAY'S INN ROAD, W.C.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.
TYNE
BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
21, JOHN STREET, ADELPHI, LONDON, W.C.

SAML. CUTLER & SONS,
MILLWALL, LONDON.

GASHOLDERS OF ALL TYPES.
MORRIS & CUTLER'S PATENT CONDENSER.
CHARLES HUNT PATENT WASHER.
CUTLER'S PATENT FREEZING PREVENTER FOR GASHOLDER CUPS.
CUTLER'S PATENT WATER-SEAL VALVES FOR PURIFIERS.

Telegrams: "RETORTUS, LONDON." Westminster Office: 16, GREAT GEORGE STREET.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
Shipments Promptly and Carefully Executed.

UNEQUALLED.

Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

TAR AND LIQUOR PURCHASED.
JOHN CLARKSON MAJOR,
(Established 1851,)
Tar Distiller and Manufacturing Chemist,
WOLVERHAMPTON.
SCULCOATS, HULL.

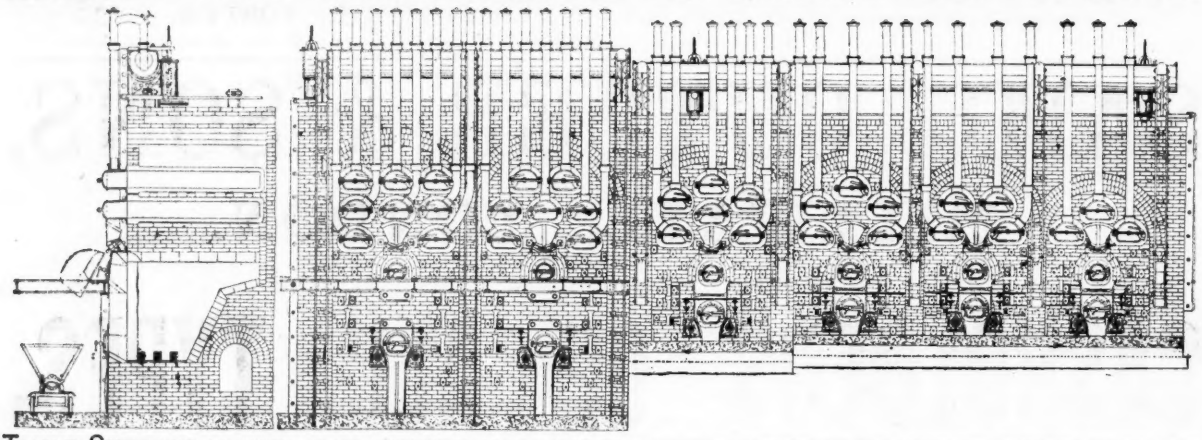
CAST-IRON PIPES
FOR GAS AND WATER.
Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.
VALVES
FOR GAS, WATER, AND STEAM.
TELEGRAMS: "PIPES GLASGOW."
WM. MACLEOD & CO.,
56, ROBERTSON STREET, GLASGOW.

COKE BREAKERS,
PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT.)
New Design, with two Cutting Rollers, making less Breeze than their old pattern.
For Exhauster Advertisement, see last week.
GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.,
And at STROUD, GLOUCESTERSHIRE.

FAMOUS LEESWOOD
"CURLEY CANNEL."
YIELD: 15,306 CUB. FT. PER TON OF 30·62-CANDLE POWER.
SMOOTH CANNEL.
YIELD: 12,321 CUB. FT. PER TON OF 21·321-CANDLE POWER.
Prices and Particulars of
MESSRS. S. CHANDLER & SONS,
LEESWOOD COAL AND CANNEL MINES,
PONTYBODKIN, nr. MOLD, NORTH WALES.

JOHN BROWN & CO., LTD., SHEFFIELD,
Proprietors of
ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.
ALDWARKE MAIN GAS COAL
Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE ADAPTED TO THE REQUIREMENTS OF ALL GAS COMPANIES AND GAS CORPORATIONS, AND HAVE ALREADY BEEN EXTENSIVELY ADOPTED. THEY ARE ERECTED UPON BOTH THE WORKING-STAGE AND SHALLOW-CHAMBER SYSTEMS, AND EQUALLY SATISFACTORY RESULTS ARE GUARANTEED IN BOTH CASES.

THE SETTINGS HAVE ATTAINED TO A MEASURE OF SUCCESS AND POPULARITY QUITE UNEQUALLED BY THAT OF ANY OTHER WITHIN THE SAME SPACE OF TIME. THE WORKING RESULTS OBTAINED, AND THE GENERAL SATISFACTION GIVEN, ARE DECLARED IN EVERY CASE TO EXCEED, AND IN MOST CASES CONSIDERABLY EXCEED, THE PATENTEE'S GUARANTEE. THE CONSTRUCTION AND WORKING OF THE PATENT PRODUCER AND THE PATENT CHARGING APPARATUS FOR SAME ARE ABSOLUTELY UNIQUE AND UNRIVALLED, AND ARE THE DELIGHT OF EVERY STOKER; WHILE IN EVERY OTHER PARTICULAR THEY SECURE THE HIGHEST RESULTS ATTAINABLE BY ANY REGENERATIVE SYSTEM, AND AT A MINIMUM OF COST.

Drawings and Specifications are furnished for the complete erection of Ovens, with or without Retort and Bench Mountings, or complete erection undertaken if required, and carried out by specially Trained Workmen.

Further particulars may be obtained on application to the Patentee's Agents: C. M. HAMILTON, 5, Stewart Street, Shawlands Glasgow; J. E. FISHER, Stourbridge, and from R. F. HISLOP (son of Patentee), Gas-Works, Paisley.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine quâ non* TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED, AND AFFORDING THE HIGHEST SATISFACTION.

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Under G. R. HISLOP'S PATENTS.

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Specially prepare GASOLINE, specific gravity ·650; CARBURINE, specific gravity ·680; or any other Hydrocarbon best adapted for Carburetting Gas.

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RICH IN ILLUMINATING POWER AND YIELD OF GAS.

ABOVE THE AVERAGE IN WEIGHT AND QUALITY OF COKE.

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FROM THE

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Available output up to 5000 tons per day. Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by Mr. John Pattinson, F.C.S., F.I.S.

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STEEL OF ALL DESCRIPTIONS.

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PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery, and other Companies.

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MANUFACTURERS OF

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(TRADE MARK "SILICA")

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Our Silica Bricks have gained a high reputation for Unsurpassed Quality in most of the leading Firms in England and on the Continent. Export orders delivered Liverpool, Hull, Grimsby, or the Tyne.

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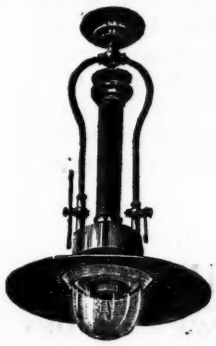

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THE "METEOR" LAMP IS

The cheapest
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The most durable
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The best and most suitable Lamp for hiring and hire-purchase. Being made entirely of fine Cast-Iron, the "Meteor" is practically indestructible. Greatly reduced prices. Liberal terms. Write for new descriptive reduced price list.

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GASHOLDERS, Telescope and Single Lift, any size. Some of the largest in the Kingdom, erected by this Firm, are giving the highest satisfaction.

PLANS and SPECIFICATIONS furnished for **Extensions** and **Enlargement** of existing **Works,** adapting them to the most **Improved** and **Modern Principle** of **Gas Manufacture.**

PURIFIERS, CONDENSERS, WASHERS, ENGINES and EXHAUSTERS, STATION METERS and GOVERNORS, manufactured and erected.

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Special reference and attention are invited to our

WET AND DRY METERS,

which have acquired a high reputation for the **excellence** of Materials and Workmanship; their **durability** and **accuracy** of **Register** guaranteed. They are used by several of the **London Gas Companies,** and over **200 Provincial Gas Companies.**

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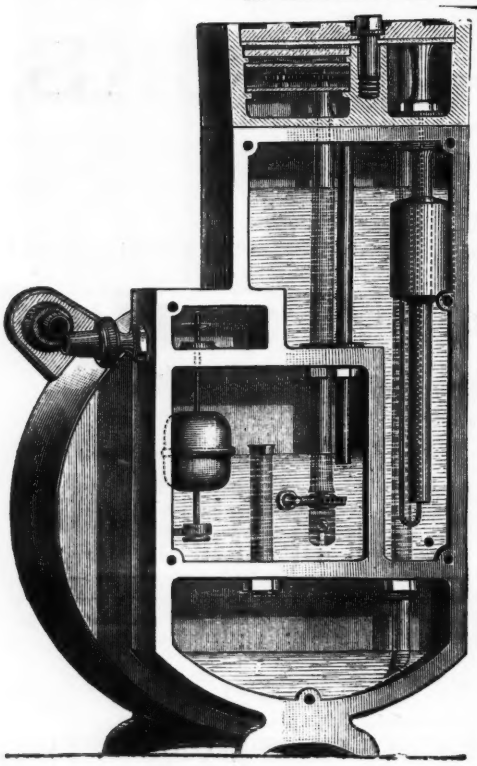
IN CAST-IRON AND TIN CASES OF THE HIGHEST EXCELLENCE.



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UNDERGROUND METER

Has been designed to obviate that which has hitherto prevented the general adoption of underground Meters—namely, their serious cost. No box is required, and the saving thus effected as compared with ordinary underground Meters, where either a box or meter-pillar is necessary, is fully one-half. The price of one for three lights is 28s., and the other sizes are correspondingly cheap. When fixed, the only part of the Meter exposed to view measures 6½ inches by 3½ inches. By the Indicator with which the Meter is fitted, the Inspector can at once discern whether water is required; but as the Meter is of the compensating description, water will probably need only be supplied ONCE A YEAR. It is advisable to fill the Meter with a non-freezing liquid, which does not injure the fittings; and this can be supplied at about 1s. 3d. per gallon.

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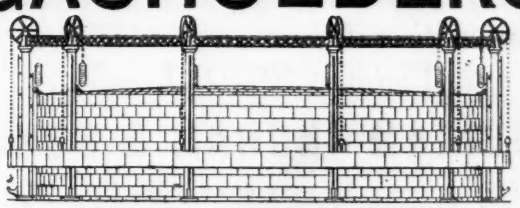

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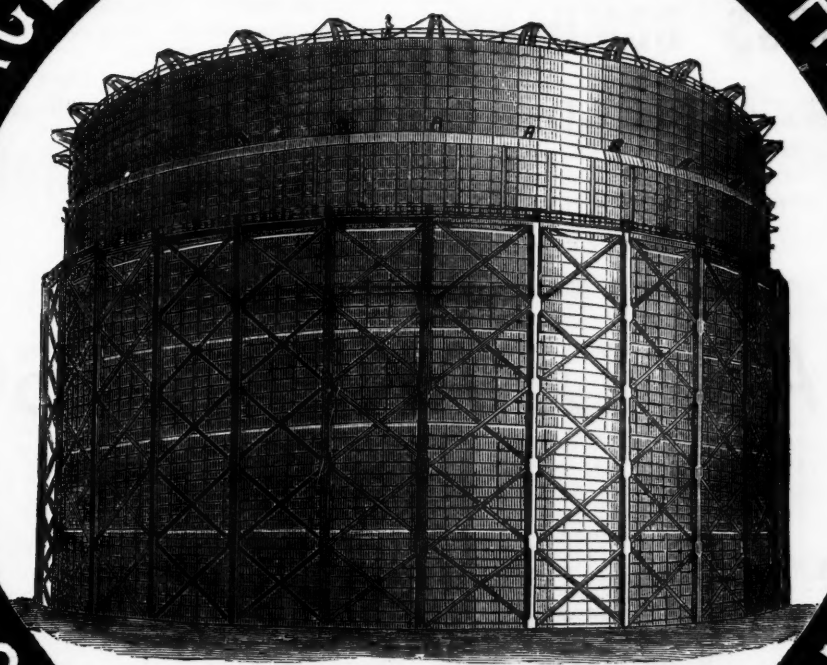

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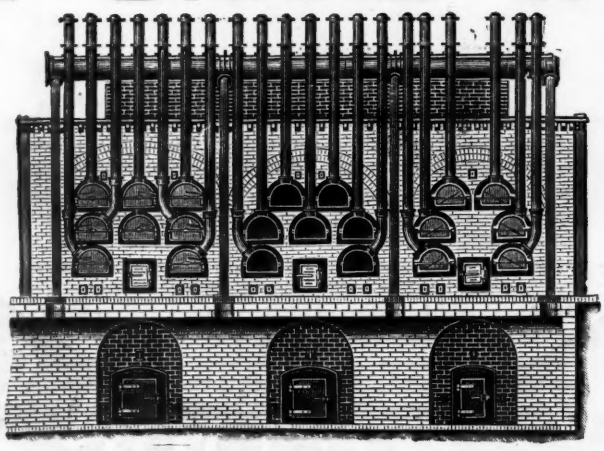

RETORT SETTERS,
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REGENERATOR AND GENERATOR FURNACES ON DRAKE'S, FRITH'S, SIEMENS'S, KLONNE'S, HASSE'S, VALON'S, SOMERVILLE'S, PONSARD'S and other Principles.

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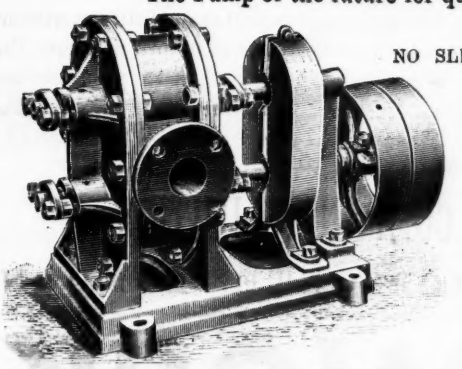
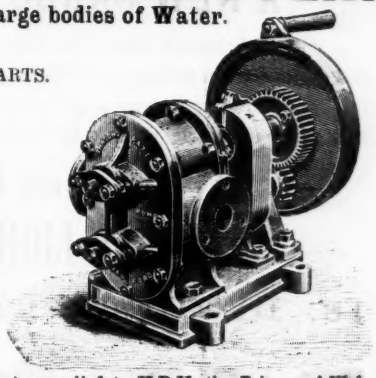


As supplied to the Harrogate Gas-Works for Pumping Gas Liquor.

NO SLIDES OR FRICTIONAL WORKING PARTS.

The Centrifugal Pump has large capacity, but is limited in power. The direct-acting Piston Pump has great power, but is limited in capacity. The Drum has the capacity of the former with the power of the latter; the advantages of both, with the disadvantages of neither.



As supplied to H.R.H. the Prince of Wales for Pumping Gas Liquor at his Sandringham Gas-Works.

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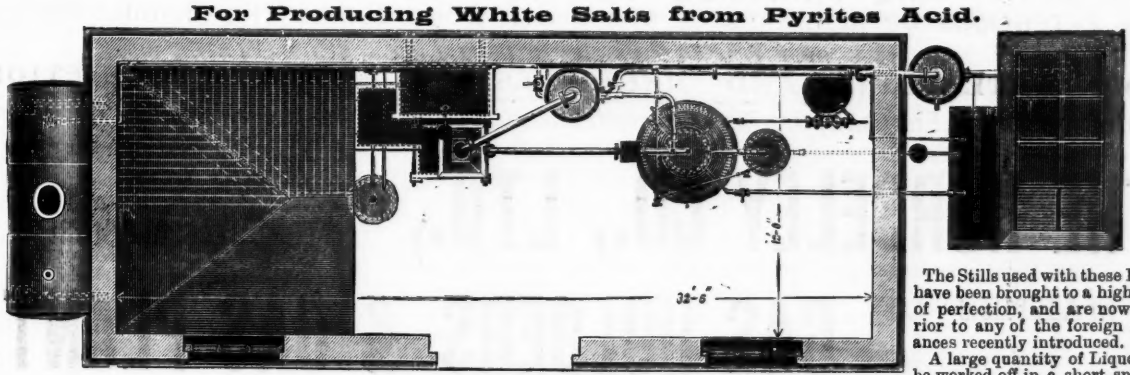
SULPHATE OF AMMONIA PLANTS

For Producing White Salts from Pyrites Acid.



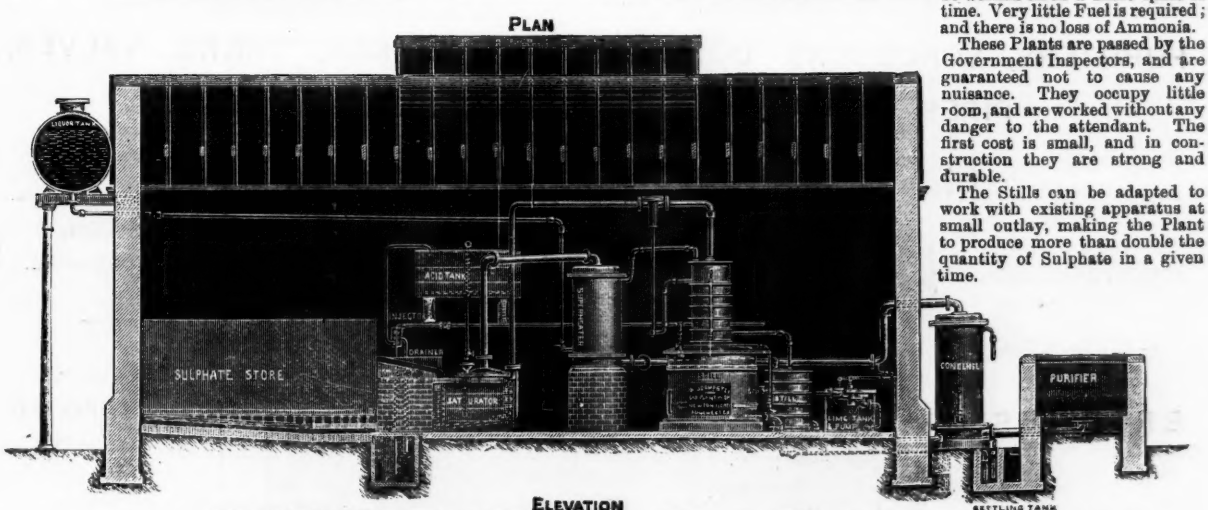
The Stills used with these Plants have been brought to a high state of perfection, and are now superior to any of the foreign appliances recently introduced.

A large quantity of Liquor can be worked off in a short space of time. Very little Fuel is required; and there is no loss of Ammonia.

These Plants are passed by the Government Inspectors, and are guaranteed not to cause any nuisance. They occupy little room, and are worked without any danger to the attendant. The first cost is small, and in construction they are strong and durable.

The Stills can be adapted to work with existing apparatus at small outlay, making the Plant to produce more than double the quantity of Sulphate in a given time.

PLAN



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A NEW CARBURETTOR FOR ENRICHING GAS IN BULK.

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FOR EXTENSIONS OR RENEWALS OF THE ABOVE WORK DURING THE ENSUING SEASON.

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BRIDGES,

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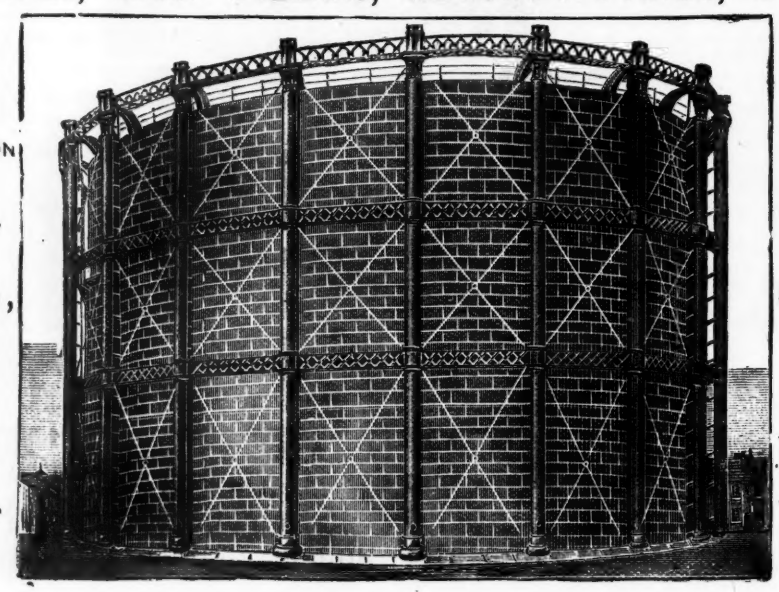

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STRONG ACTION ON SULPHURETTED HYDROGEN.
We have for sale Hydrate of Iron containing 77 per cent. of Ferric Oxide and 17 per cent. of Water. Directions given for mixing for Purifiers.
LESS THAN HALF THE PRICE OF BOG ORE.

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SOOTHILL WOOD CANNEL.

Yield of Gas per ton, over 12,000 cubic feet.
Illuminating Power - - - 26 candles.
Coke per ton - - - - - - 57 per cent.
Of a quality almost equal to that made from the best Coking Coal.

For Analysis and Price, apply to
THE SOOTHILL WOOD COLLIERY Co., LD.,
SOOTHILL WOOD COLLIERY,
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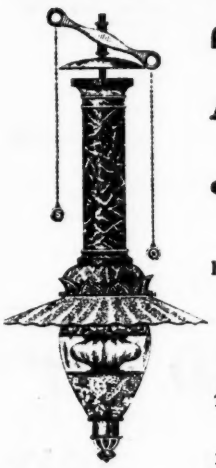
The Climax of Regenerative Gas Lighting!!



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A 280-CANDLE POWER
PLAIN IRON LAMP,
CLASS A— 55/-
LIGHT for LIGHT
less than half the price of any other Regenerative Lamp.
Manufactured in England by
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PARTICULARS AND PRICES FREE. AGENTS WANTED.

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INCORPORATED IN
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MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.
RETORTS CAREFULLY PACKED FOR EXPORT.
Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

WILSON CARTER & PEARSON,
GAS COAL AND CANNEL FACTORS,
Supply to any Railway Station, or for Export, all kinds of Fuel for Gas purposes.
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THE THAMES BANK IRON CO.
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SUPPLY FROM STOCK
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